California Independent
System Operator Corporation

Competitive Path Assessment for MRTU Preliminary Results – Release 3

Department of Market Monitoring

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TABLE OF CONTENTS

1 Executive Summary

The final path designations resulting from the Competitive Path Assessment (CPA) will be used to establish the set of transmission paths applied in the two market passes of MRTU where Local Market Power Mitigation (LMPM) is applied. This white paper is intended to provide information to Stakeholders and Regulatory Agencies on preliminary results of the CPA along with a detailed description of modeling, data, and testing practices used in performing simulations and ultimately making competitive path designations.

This third release of CPA results evaluates path competitiveness across four seasons, three load scenarios (high, medium, and low), three hydroelectric production scenarios (high, medium, and low), and combinations of the five largest suppliers' internal generation withdrawn from the model. The methodology, input data, and simulation model are exactly the same as in the second release of preliminary results except for one item. For this release, the CAISO collected information from market participants regarding contractual transfer of operational or bidding control of physical generation assets in the CAISO control area and adjusted the portfolios of the potentially pivotal suppliers to reflect this change in control. Only tolling agreements that were in effect during the MRTU period of 2008 and were verified through comparison survey responses from counterparties were incorporated into the study. In cases where a tolling agreement shifted control from one participant to another, that shift was reflected in the generation portfolios of the respective participants in the simulation model. The pool of suppliers considered is still based on a 1,000 MW threshold for the portfolio of internal generation, however the number of suppliers that met this criteria was reduced compared to that of Release 2 due to portfolio adjustments to reflect the tolling agreements collected through the survey. For more information, please refer to Section 4.6 of this report.

As with the simulations used to produce prior sets of preliminary results[1], simulations for this release do not include explicit use of N-1 contingencies via Security Constrained Unit Commitment (SCUC). The California ISO (CAISO) intends to apply additional N-1 security constraints through the SCUC feature of the MRTU market optimization on an as-needed basis as dictated by grid conditions. Note that while not explicitly enforced through SCUC each interval, the CAISO will be using corridor limits that have been established by off-line security analysis to ensure that the pre-contingency limits are such that if a contingency occurs the CAISO is operating in a secure state. Given the situational application of N-1 security constraints in SCUC, the CAISO's Department of Market Monitoring (DMM) did not feel it would be appropriate to apply additional security constraints on a consistent basis in the CPA simulations while those constraints will be applied differently (possibly a subset of the full set of security constraints) and less frequently during actual market operation.

Results for seasonal benchmark cases are presented in addition to summary results for 936 one-day simulation runs, 234 simulation runs for each of four seasons reflecting the various load and hydro scenarios as well as withdrawn capacity for combinations of

[1] Previous release results can be found here: http://www.caiso.com/docs/2005/07/01/2005070111120583480.html

potentially pivotal suppliers. This paper presents the calculated Feasibility Index (FI) metric and results of the competitive test for each season under two different test thresholds.

There are 24 aggregated candidate paths which are composed of multiple transmission segments as well as 84 single candidate paths which are made up of individual transmission segments (not associated with aggregated candidate paths) tested in this release. Using a zero-tolerance threshold where any negative FI value constitutes failure of the competitive test, no individual candidate path failed any test in this study. However, In the Spring scenarios 6 of 24 aggregated candidate paths failed the competitiveness test and in the Summer scenarios, 3 of 24 aggregated candidate paths failed the tests, two of which already failed in Spring. Due to relatively lower demand, none of the candidate paths failed in the Fall and Winter seasons. Overall, 17 of 24 aggregated candidate paths and all 84 single candidate paths passed the test and were deemed competitive paths in this study.

It is important to note that by default, all paths are deemed uncompetitive except for "grandfathered" paths (existing branch groups). Aside from existing branch groups, only paths that are selected as candidate competitive paths AND pass the test for competitiveness will be deemed competitive. Of the 4,860 individual transmission segments in the CRR FNM, roughly 2.5% (122/4,860) are "grandfathered" competitive, 3.3% (160/4,860) are selected as candidates for testing, and 2.7% (133/4,860) are deemed competitive through testing

2 Background for Competitive Path Assessment

Local Market Power Mitigation and Reliability Requirement Determination (LMPM-RRD) under MRTU requires prior designation of network constraints (or paths)[2] into two classes, "competitive" and "non-competitive." Under the MRTU LMPM-RRD procedures, generation bids that are dispatched up to relieve congestion on transmission paths pre-designated as "non-competitive" are subject to bid mitigation.[3] In its MRTU Tariff Filing, the CAISO proposed to designate all of today's existing zonal transmission branch groups as "competitive" and undertake a study prior to MRTU implementation to determine whether additional transmission paths could be designated as "competitive" for day one of MRTU. Thereafter, the CAISO proposed to reevaluate path designations on an annual basis or sooner if system or market conditions changed significantly.[4]

LMPM-RRD in MRTU will be applied in a two-step process that is used to identify specific circumstances where local market power exists. This process occurs just prior to running the market (day-ahead or real-time) and applies mitigation to resources that have been identified as having local market power. All transmission facilities that are

[2] The term path is used synonymously with transmission constraints in this context, and includes all transmission constraints that are enforced in Pass 1 and Pass 2 of Pre-IFM. A path is by definition directional.

[3] A detailed description of the MRTU LMPM-RRD procedures can be found in the MRTU Tariff and MRTU Business Process Manuals on the CAISO web site at http://www.caiso.com/docs/2001/12/21/2001122108490719681.html.

[4] Specifically, the CAISO may perform additional competitive assessments during the first year if changes in transmission infrastructure, generation resources, or load in the CAISO Control Area and adjacent Control Areas suggest material changes in market conditions, or if market outcomes are observed that are inconsistent with competitive market outcomes.

modeled in the FNM have a designation of “competitive” or “non-competitive.” The first step of this process clears supply against forecast demand, with thermal limits enforced only on the set of competitive constraints (the “Competitive Constraint Run (CCR)”). This provides a benchmark dispatch that reflects competition among suppliers since only those transmission constraints deemed competitive are applied in the network model. The second step applies all constraints, competitive and non-competitive, and re-dispatches all resources to meet forecast load. In this second step, the “All Constraint Run (ACR),” some resources will be dispatched further up (compared to the CCR) to relieve congestion on the non-competitive constraints now that they have been applied in the market solution. Those resources that have been dispatched up in the ACR relative to the competitive benchmark dispatch from the CCR are deemed to have local market power since they were needed to relieve congestion on a non-competitive constraint and will have their bid curve mitigated to their Default Energy Bid from the CCR dispatch point to the full bid-in output for that resource.

The Competitive Path Assessment is based on a Feasibility Index (FI) methodology that was developed through an extensive stakeholder process in 2005. Alternative approaches, including those used by PJM Interconnection (PJM) and Midwest ISO (MISO), were considered and reviewed at Stakeholder Working Group meetings held in the latter part of June through mid-July 2005. Among all the options considered, the FI methodology had certain conceptual advantages as well as the greatest support within the Stakeholder Working Group and thus was the approach adopted and filed with FERC.

Over the past year, DMM has developed the modeling tools and input data for conducting the CPA and has completed some initial demonstration results. This draft report provides a review of the study approach and demonstration results. The draft report will be shared and reviewed with stakeholders in order to solicit input and recommendations on potential refinements to the methodology and presentation of results. It is important to note that this set of results are preliminary and that additional updates, including candidate path identification and network model specification, will be completed in addition to publishing a full set of seasonal results prior to finalizing results.

A detailed description of the FI methodology is provided in the next section. This is followed by a review of the various modeling assumptions and input data. The demonstration results are provided next. The report concludes with a discussion of next steps for further refinements and modifications.

3 The Feasibility Index Methodology

Transmission constraints increase the potential for exercising market power by raising the level and decreasing the elasticity of effective demand curves facing generators. There are several distinct types of market power opportunities that transmission constraints can present. The most familiar is high concentration of supply within load pockets. In that case, by withholding capacity, local generation can induce congestion on connecting paths, creating an uncompetitive situation for the residual demand in that location. Another example involves the interaction of generation controlled by a single supplier in different parts of the network; in certain situations, market power can be exercised by pricing a generator at one location below marginal cost in order to deliberately create congestion that raises prices for other generators at other locations.[5]

The focus of this competitive path analysis is the identification of transmission constraints that result in the first type of uncompetitive conditions: high concentration in the supply-deficit areas. This is arguably the most prevalent and well-known set of market power problems caused by transmission.

Pivotal supplier analysis is central to competitive path assessment. It is a common feature of the MISO and PJM methodologies, although those ISOs have different methods of determining the relevant supply and demand for pivotal supplier analysis. They both use generation shift factors, but their choice of the slack bus(es) for determination of generation shift factors is different. In general, and specifically in both cases of MISO and PJM, the choice of the slack bus(es) for determining the shift factors is rather arbitrary and has a potentially important impact on the outcome of the pivotal supplier analysis. The Feasibility Index methodology used here addresses the pivotal supplier analysis without the need to designate a slack bus(es) for the determination of the shift factors. In fact, the FI approach does not even use the shift factors. This is advantageous, because the choice of shift factors will always be somewhat arbitrary, and the location of the INC (DEC) that matches the assumed DEC (INC) of a resource in question will depend on system conditions and economics. An additional advantage of the proposed method is that the method is comprehensive in that it considers the interacting effect of all constraints at once.

The methodology for CPA starts by selecting one or more representative system conditions, load levels (and load distribution), and supply resources that would normally be available (not on forced or maintenance outage) under the assumed seasonal conditions. For a given set of load, network, and supply conditions, the question is whether there are pivotal suppliers in the sense that without their combined supply participation congestion will exist and cannot be resolved on the path in question (and thus some load would potentially be unserved in some local area). If there are such pivotal suppliers, the path in question is non-competitive under the given set of conditions.

The general concept underlying the FI methodology is to take out all supply resources of one or more specific suppliers and determine if the remaining suppliers' resources can be scheduled to meet the load subject to the transmission constraints, i.e., if a feasible solution exists with the remaining supply. This is done simultaneously for the entire system's set of loads, resources, and transmission facilities. if a feasible solution does exist, the supplier(s) in question are not pivotal for congestion relief on any path under the set of supply/demand/system conditions. Otherwise the supplier(s) in question are pivotal for congestion relief on the paths that cause solution infeasibility.[6]

[5] J. Cardell, C.C. Hitt, and W.W. Hogan, "Market Power and Strategic Interaction in Electricity Networks," *Resource and Energy Econ*., *19*(1-2), 1997, 109-137.

[6] This is equivalent to the effective demand curve for the supplier's generation becoming vertical at some positive quantity at some location. Therefore, it is appropriate to view competitive path analysis as simply being a logical

To identify those paths and quantify the relative degree of infeasibility each causes, we define a Feasibility Index for each transmission constraint with respect to each supplier. To define the FI index, we modify the production cost optimization, which is based on a FNM of the CAISO Control Area, by treating all non-grandfathered transmission constraints as soft constraints with very high penalties (orders of magnitude higher than the highest bid price or the prevailing bid cap) for violating the constraint. Thus, instead of getting no solution, we would get a "least cost" solution in which some transmission flows exceed the transmission (constraint) limit. As discussed earlier, the current inter-zonal branch groups are considered "competitive" and therefore are enforced as hard constraints in the optimization.

For a single supplier i whose resources are removed, we define the FI (i,j) of Path j with respect to Supplier i as follows:

Let

Limit (j) = Transmission Limit on Path j

Flow (i,j) = Power Flow on Path j without Supplier i's Resources (with soft limits)

Then

FI (i,j) = [Limit (j) - Flow (i,j)] / Limit (j)

If FI (i,j) is negative, supplier i is pivotal for congestion relief on the system, in particular on Path j. If FI (i,j) is positive, supplier i is not pivotal for congestion relief on Path j (in combination with the other constraints), but if FI (i,j) is small, it is possible that the supplier j could be jointly pivotal with another supplier k having a small feasibility index FI (k,j) on the same path j. The pivotal supplier criteria that the CAISO adopted and filed with FERC is a "no three pivotal supplier" criteria (i.e., candidate paths that have a negative FI when up to three suppliers are removed from the market are considered "non-competitive").

The following generic matrix demonstrates the single pivotal supplier test results for n candidate paths. Table 1 shows a matrix of Feasibility Index results for n candidate paths (P1 – Pn across the top of the matrix) with various suppliers removed from the model (individually). In this case, the sign of FI (i,j) indicates whether supplier i is pivotal with respect to any of the candidate constraints.

Table 1. FI Matrix

Paths ⇨ Suppliers ⇩	P1	P2	…..	Pj	….	Pn

generalization of pivotal supply analysis to a market with transmission constraints. An important implication is that methods based on complex manipulations shift factors and which don't consider all interacting constraints (such as the MISO approach) may actually fail to identify all situations where a generator is pivotal due to transmission constraints. This can be shown on simple two node networks.

S1	FI(1,1)	FI(1,2)				FI(1,n)
S2	FI(2,1)	FI(2,2)				FI(2,n)
.						.
Si				FI(i,j)		FI(i,n).
.						.

If a FI (i,j) entry is negative for any Supplier i, Path j is non-competitive. If all FI(i,j) entries are positive for Path j, but some are small (below a designated threshold), then the test is repeated with the supply resources of both suppliers removed. The test will be repeated again with the supply resources of three suppliers removed if all FI(I,j)n entries are positive for path j if two suppliers' resources are removed.

For any candidate path that shows FI < 0 for a specific test case (supplier combination removed, load scenario, hydro scenario), that path is designated *Non-Competitive* for purposes of applying LMPM-RRD in MRTU. Such a designation means the path limit will not be enforced in the CCR and will be enforced in the subsequent ACR where identification of local market power is performed.[7] Any candidate path that has FI ≥ 0 under all test conditions is designated *Competitive* for purposes of applying LMPM-RRD in MRTU and the thermal limit for that candidate path will be applied in both the CCR and ACR where LMPM-RRD is performed.

4 Implementation of the FI Methodology for MRTU

4.1 Simulation Methodology

The simulation follows the basic power flow concept and is being developed to most closely match the market design and optimization that will be used in MRTU. Simulations for this round of preliminary CPA results were performed in PLEXOS.[8] Specifically, the CPA simulation includes the following features:

- Unit commitment: An inter-temporal optimization is used that selects resources to be committed over the single day (24 hour) simulation period based on their start-up cost, minimum load cost, minimum run time, minimum down time, ramping up/down limits, and energy bids (cost-based in this simulation) compared to potential revenues available to that resource if committed across some or all of the hours in that day. The approach applied in this simulation is

[7] See prior section for description of CCR and ACR in the context of applying LMPM-RRD.
[8] Additional information on PLEXOS is available at http://www.energyexemplar.com/main.asp?page=overview.

the Rounded Relaxation (RR) algorithm.[9] The primary reason for using this approximation (compared to mixed-integer algorithm) is its computational efficiency, which is important in light of the number of simulations that must be run to reflect the various supplier combinations withdrawn from the model and the various load and hydro scenarios.

- Co-optimization of Energy and Ancillary Services (A/S): The simulation co-optimizes energy procurement and A/S procurement. A/S prices in MRTU will reflect both the capacity price for the service as well as the opportunity cost for energy. Because the CAISO does not have a cost basis for A/S capacity bids, a capacity price of zero is used in the simulation and only the opportunity cost of selling A/S is reflected in the optimization.[10]

- Transmission Constraints: The simulation models inter-zonal transmission interface (branch groups) limits as hard constraints, and all other transmission facility limits, such as individual transmission lines and candidate paths, as soft constraints (as described in the FI methodology section) with a penalty price of $50,000/MW/hr for constraint violation.

- Penalty for Dropped Load: A penalty price of $1,000,000/MW/hr is used for load curtailments. This (relatively) high penalty price, along with the $50,000/MW/hr transmission constraint penalty price, ensures that no reasonable economic substitution would take place between the options of dropping load, dispatching additional generation, and violating a transmission soft constraint. It allows the simulation model to find solutions with dropped load in cases when the amount of load at some nodes within a region or regions could not be met since too much generation capacity is removed from the region/regions and the importing capabilities from adjacent/nested control areas are restricted by branch group hard limits.

- Economic dispatch with Direct Current Optimal Power Flow (DC-OPF) that mimics the MRTU day-ahead (DA) market process. Note that the DC-OPF

[9] The RR algorithm converts the unit commitment decisions into a two-pass optimization. In the first pass, the unit commitment on/off integer decision variables are relaxed and linear relaxation results are found. Then the unit commitment decision variables are fixed at the nearest round-up integer point without violating any integer constraints. In the second pass, the final optimization solution is obtained with the fixed unit commitment integer variables. The main reason to choose RR algorithm is due to performance issues. The RR is much faster compared to a full Mixed-Integer Program (MIP) algorithm because it uses two passes of linear programming rather than a full blown integer programming. The MIP algorithm may take up to twenty times longer to solve one case while the objective function improvements are usually negligible.

[10] While the use of $0 / MW capacity bids for A/S may not reflect actual bids observed in MRTU and consequently introduce a deviance from expected procurement resulting from the co-optimization of energy and A/S. However, we believe this will not impact the competitiveness test via the likelihood of observing a negative FI. The reason for this is that the FI test is a physical feasibility test where pass/fail is triggered by line overflow that is allowed through the use of a soft constraint on the candidate transmission paths and discourages through the use of an extremely high penalty price for violating the soft constraint. In cases where a soft constraint may be violated, unit commitment, energy procurement, and A/S procurement will be driven by cost avoidance (avoiding the extremely high penalty price) rather than the relatively trivial difference between one A/S capacity bid price and another. The simulation model will necessarily commit a new unit, procure additional energy from a unit, or procure A/S from any unit that can reasonably aid in penalty price avoidance.

approach does not explicitly model losses or reactive power flows. Losses are implicitly accounted for in the model through the use of load values (in the simulations) that come from final metered load data, which are net of losses.

- Zonal Ancillary Service Procurement: A/S are procured with zonal requirements enforced, where an approach of "concentric" zones is used when requirements are overlapping. The simulation, however, does not explicitly account for A/S procurement from outside the CAISO control area due to limitations in the simulation software for reserving transmission on the inter-ties for the potential import of energy from A/S procured outside the control area. To account for A/S imports, an implicit approach was taken where a portion of the total (calculated) A/S requirement is assumed to come from imports based on historical procurement, so that (a) the total A/S requirement is adjusted down to account for historical A/S imports and (b) individual inter-tie interface (Branch Group) transmission capacities are reduced by the historical seasonal hourly average A/S procured from across those interfaces. The simulation model only procures the upward regulation services (i.e., no Regulation Down) since procurement of downward reserves would not impact the feasibility of the power flow model with any amount of capacity removed.

DMM had originally intended to include multiple contingency-based Security Constrained Unit Commitment (SCUC) and Dispatch in the optimization routine so that the resulting optimization more closely reflected market optimization under MRTU. While the MRTU software will have the capability to run a SCUC optimization, the CAISO intends to apply additional N-1 security constraints individually on an as-needed basis as dictated by grid conditions. Note that while not explicitly enforced through SCUC each interval, the CAISO will be using corridor limits that have been established by off-line security analysis to ensure that the pre-contingency limits are such that if a contingency occurs the CAISO is operating in a secure state. Given the situational application of N-1 security constraints in SCUC, DMM did not feel it would be appropriate to apply additional security constraints on a consistent basis in the CPA simulations while those constraints will be applied differently (possibly a subset of the full set of security constraints) and less frequently during actual market operation. DMM does not intend to apply SCUC optimization in the CPA.

4.2 Network Model

The network model used for the final competitive path assessment studies will be very similar to the proposed full network model (FNM) that will be used in the MRTU market design. For the Round 2 of Preliminary Results presented here, the network model used for the CPA is the same as the Congestion Revenue Rights Full Network Model (CRR FNM) that the CAISO released to market participants in early August, 2007 (named DB18 sub-version A) and later applied the patch released on August 28th (DB18 sub-version B). This model was developed with the intention to be as consistent as possible to the proposed FNM that will be used in the MRTU market design in terms of the transmission connectivity with adjacent and embedded control areas as well as the transmission outside of the CAISO control area that is part of the CAISO Controlled

Grid. This CRR FNM is a bus-branch oriented network model which is derived directly from MRTU FNM software using the CRR FNM exporting interface developed by Siemens. The exported network model was then examined by the CRR team to ensure all elements in the model reflect typical conditions in our system (see the Business Practice Manual for Managing the Full Network Model[11] for additional information). This base PTI format bus-branch model was then imported into the PLEXOS simulation model for competitive path assessment effort.

Along with the CRR FNM, related data such as thermal branch limits, the load distribution factor, Pricing Node (PNode) and Aggregated Pricing Node (APNode) mapping, and transmission corridor and nomogram/interface constraint definitions were also imported into the simulation model. This data is consistent with the data the CAISO will use in the first annual CRR Allocation and Auction production processes (i.e., in the simultaneous feasibility test (SFT) processes). The thermal branch limits data is comprised of the summer and winter thermal limits (normal and emergency MVA limits) for a selected set of branches.[12] For the competitive path assessment study, we only enforced normal thermal branch limits for branches with both ends at 60kV or above and that reside completely within the CAISO control area. Minor changes were made to the limits of a handful of individual transmission lines within the CAISO control area on ad-hoc basis so that the base case power flow resembles the actual flow in the system. In these limited cases, the line ratings were relaxed from normal operating limits to their emergency limits to calibrate baseline flows for the Summer Medium Hydro Medium Load case.

The nomogram/interface constraints were enforced with the simultaneous flow limits that the CAISO currently anticipates enforcing in the MRTU markets. The same weighting factors for each line or transformer that make up the constraints in the CRR FNM are also incorporated in the CPA simulation model.[13]

It has been suggested that the transmission limits across the interties be adjusted downward in the simulation to reflect historical decline rates for import bids across the interties that effectively limit the amount of energy the CAISO can import (in real time) beyond the limits of the interties. The CAISO is currently pursuing changes to the market rules for the start of MRTU that will impose an additional charge on declined dispatches across the interties that is intended to deter SCs from declining import dispatches. An effective deterrent for declined import dispatches is a more direct means of addressing this modeling issue.

More specifically, all of the 4,860 transmission lines/transformers, 4,097 buses, 45 inter-zonal interfaces, and 64 local area nomogram constraints from the CRR FNM are imported into the simulation model for this initial competitive path assessment study.

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[11] Please refer to http://www.caiso.com/1840/1840b27422f60.html for detailed information.

[12] Note that the thermal branch limits are scaled by a factor of 97% to account for losses and additional factor of 97% to account for reactive power since the CRR FNM is a lossless DC FNM. The effect is to reduce thermal limits by just under 6%.

[13] The CPA, CRR, and MRTU applications will be using the same FNM, albeit versioned depending on the FNM available at the time the application requires it. The FNM is available to market participants and their agents through the CRR Dry Run process and requires signature of a Non Disclosure Agreement. Please refer to the CAISO web site for more details on obtaining the CRR FNM.

4.3 Grandfathered Competitive Paths

According to the competitive path methodology filing, all CAISO's current inter-zonal interfaces (i.e., branch groups) are considered grandfathered competitive paths and will be applied as hard constraints (i.e., constraints that can not be relaxed by using a soft-constraint with a penalty price) in the simulation. Table 15 (later in this document) shows the current inter-zonal branch groups and the Operating Transfer Capability (OTC) limits on both import and export directions that are incorporated in the current competitive path study network model (figures shown are for the spring base case simulation). These grandfathered paths are selected from the predefined CRR FNM interface/nomograms, most of which correspond to the current Branch Group definition found here.[14]

4.4 Additional Transmission Limits

In addition to the transmission interfaces discussed above, additional transmission constraints, which are also adopted from the CRR FNM, are included in this model and modeled as soft constraints for the competitive path assessment. Some transmission constraints define import/export limits to areas within existing congestion zones, such as the San Francisco, Fresno, and North Bay areas, while others limit network flows but do not surround geographic areas, such as Miguel substation in San Diego, Vincent substation, and simultaneous flow limits within the Bay Area. In addition to all individual line/transformer limits at 60 kV and higher voltages and interfaces, the transmission constraints used in this study include the transmission constraints listed below.

Regional Import Limits

- Southern California Import Transmission (SCIT).

Southern California Edison Area

SCE Transmission Limits	SCE Transmission Limits
Antelope - Vincent	South of Lugo
Barre-Lewis 220 kV	South of Magunden
Barre-VillaPark 220 kV	Sylmar Banks
Eagle Mtn 230/161 kV	Victorville-Lugo (ED-LG)
Mangunden-Vestal1-2 220kV	Victorville-Lugo (HA-NG)
MiraLoma Bank 1AA-2AA	Victorville-Lugo (LG-MH)
MiraLoma Bank 3AA-4AA	Victorville-Lugo (LG-VN DLO)
Serrano Bank	Victorville-Lugo (PV-DV).

San Diego Gas and Electric Area

SDG&E Transmission Limits	SDG&E Transmission Limits
ElCentro 230/161 kV Bank	Miguel Max Imports
Imperial Valley Bank	SDGE and CFE Imports
Miguel 500/230 kV Banks	SDGE Imports

[14] http://www.caiso.com/1c10/1c10d95330250.xls

Pacific Gas and Electric Area

PG&E Transmission Limits	PG&E Transmission Limits
Bogue Area Import	Panoche-Kearney & Dairyland-LeGrand
Colgate 60 kV	Pittsburgh Transformer
Contra Costa 230kV Import	Pittsburg to San Mateo_E. Shore
Drum - Rio Oso Limit 1 (outflow)	Placer - Gold Hill #2
Drum - Rio Oso Limit 2 (outflow)	Ravenswood Cutplane
Drum - Rio Oso Limit 3 (outflow)	Ravenswood to San Mateo
Gates - McCall & Helm - McCall	Rio Oso Banks
Gates-Gregg & Panoche-Kearney	Schulte - Kasson
Humboldt Bank	Schulte - Kasson & Tesla
Humboldt Imports	Sobrante - Grizzly - Claremont
Indian_Spring	Table Mt - Rio Oso
Keswick-Cascade	Table Mt - Rio Oso & Palermo
Llagas to Gilroy	Table Mt-Rio & Vaca
McCall Banks 2 & 3	Tesla - Manteca
Metcalf to Morgan Hill	Tesla Banks 4 & 6
Monta Vista - Jefferson	Tesla Banks 6 & 4
Moss Landing to Metcalf	Tesla to Delta Switchyard
North Geysers Export	Tesla to Pittsburg
Oakland 115kV	Vaca Bank & Tesla Bank 6
Palermo - Colgate	Vincent Bank.
Palermo 115kV	

4.5 Assumptions About System Conditions

4.5.1 Demand Forecast

The purpose of the preliminary studies is to assess the competitiveness of the candidate paths using a wide range of system supply and demand conditions. For this purpose, we construct three demand forecast scenarios as follows. First, actual 2006 loads for the PG&E, SCE, and SDG&E transmission areas have been obtained from telemetry data. From this data, a seasonal CAISO system-wide daily peak load duration curve is created to represent the 2006 peak load condition in that season. Three load scenarios are chosen for each season by selecting individual days within a season that correspond to specific points on the daily peak hour load duration curve for that season. Currently, the high, medium, and low load scenarios are chosen based on the 95th percentile, 80th percentile, and 65th percentile respectively for the daily peak hour load duration curve for each season.

For example, the summer season has 92 daily peak values, one for each day during July, August, and September. A cumulative distribution is calculated for these daily peak load values during the summer of 2006, and the low, medium, and high load scenarios for summer 2006 are identified by the three individual days where 95%, 80%, and 65% of daily peak load values are below the load value for those days. These three days are identified as July 26, July 15, and August 24 respectively. The following table summarizes the days identified for various load scenarios in each season.

Table 2. Selection of Typical Day for Seasonal Load Scenario

Load Scenario	Spring	Summer	Fall	Winter
High	6/23/2006	7/26/2006	10/23/2006	1/9/2006
Medium	6/4/2006	7/15/2006	10/19/2006	2/1/2006
Low	5/11/2006	8/24/2006	10/20/2006	3/21/2006

The following table shows the assumed CAISO system daily peak load for various load scenarios in each season for this initial study.

Table 3. System Daily Peak Load for Three Load Scenarios by Season (MW)

Load Scenario	Spring	Summer	Fall	Winter
High	41,971	47,604	32,430	31,407
Medium	35,362	42,637	31,628	31,062
Low	33,279	40,611	31,108	30,784

Since the loads calculated from telemetry data are actually the sum of loads plus losses, for simulation purposes the estimated losses of 5% have been subtracted to produce local area loads net of losses at the take-out points to accommodate use of lossless DC-OPF simulation approach. Fixed load distribution factors from the CRR FNM are incorporated in the CPA simulation model.

4.5.2 A/S Modeling and A/S Requirements

Co-optimizing A/S and energy in the day-ahead market (DAM) is an important feature of the CAISO's new market design. In the MRTU DAM, suppliers can provide both energy bids and A/S bids, and the DAM will procure 100% of the requirements. A/S requirements are closely related to load forecasts. In this initial competitive path assessment study, a simplified A/S and energy co-optimization process is adopted. First of all, unlike the 10 A/S regions that may be considered in the initial release of the MRTU DAM,[15] we simply consider two A/S regions: System, and South of Path 26 (SP26), because these two are the most important A/S regions based on the ISO historical operation experiences. The minimum requirements for each of these two A/S regions are calculated using the following rules.

System A/S Region:

- Regulation Up (RU) Minimum Requirement: 400 MW.

[15] The 10 A/S regions implemented initially for MRTU Release 1 are: Expanded System, System, South of Path 15, Expanded South of Path 15, South of Path 26, Expanded South of Path 26, North of Path 15, Expanded North of Path 15, North of Path 26, Expanded North of Path 26.

- Operating Reserve (OR) Minimum Requirement: 7% of system load minus historical DA final OR imports to CAISO.

SP 26 A/S Region:

- Operating Reserve (OR) Minimum Requirement: 40% of (7% of system load) minus historical DA final OR imports to SP26.

The simplified A/S zonal model used in the CPA simulations is a deviation from both the 10 zone model that can be accommodated by MRTU and the system wide procurement model that may be used during the first year of MRTU until additional experience with A/S procurement under MRTU evolves. It is important to note that the 10 zone model involves concentric zone definitions with NP26 and SP26 remaining the primary procurement zones. The CAISO recognizes that the simplified model of A/S procurement zones will affects the simulation results, however we believe that the small amount of historical A/S procurement across the interties coupled with the primary procurement zones of NP26 and SP26 represented in the simulation model will minimize any distortionary impacts of the simplified A/S procurement model used in the CPA simulation. Furthermore, the software currently used to perform the CPA simulations is limited in its ability to mimic A/S procurement across the interties as modeled in MRTU. Once this capability is further developed, the CAISO will model A/S procurement across the interties as well as consider more granular A/S procurement zones should it become clear that the CAISO is taking that direction.

Spinning Reserve and Non-spinning Reserve are combined into a single product, Operating Reserve, for the CPA simulations. Any resource certified to provide Spinning Reserve or Non-spinning Reserve is certified to provide OR in the simulation model. With this approach, we do not distinguish between units that are running and those that are not when procuring OR. However, in cases where suppliers have their portfolios removed from the model, most if not all remaining internal resources are up and running. Combining Spinning and Non-spinning reserves is done to simplify the simulation model and improve computational efficiency. This simplification may result in lower unit commitment as some resources certified only for Non-spinning reserve may be used to provide Spinning reserve. This effect is dependent on the amount of certified Non-spinning capacity that can be substituted for Spinning reserve requirement, which is currently only about 325 MW system wide. For perspective, the combined OR requirement can be as much as 3,100 MW on a peak summer day (see Table 4 below). The procurement rules for Ancillary Services do allow substitution of Regulation Up Service for OR Service. So, for example, the model allows additional Regulation Up capacity to be procured to satisfy the OR requirement if that solution was least-cost. This type of substitution is called Cascading in MRTU.[16]

Note again that A/S requirements are correlated with load forecast scenarios in this study. For example, the summer high load scenario day is identified to be August 16, 2006. Thus the hourly system OR requirement corresponding to the high load scenario

[16] Please refer to Market Operation Business Practice Manual for detail information. BPM can be found at: http://www.caiso.com/17e9/17e9d7742f400.html .

is calculated as 7% of the hourly system load (from August 16, 2006, load data) less the hourly DA final OR imported to the CAISO control area on that day.

The following table shows assumptions for System and SP26 regional minimum operating reserve requirements in various seasons under various load scenarios at the daily peak hour.

Table 4. Minimum Operating Reserve Requirement at Daily Peak Hour (MW)

Load Scenario	Region	Spring	Summer	Fall	Winter
High	System	2,678	3,109	2,168	2,005
	SP 26	1,024	1,271	830	728
Medium	System	2,214	2,815	2,112	1,980
	SP 26	831	1,152	809	724
Low	System	2,070	2,611	2,068	1,947
	SP 26	805	1,074	802	727

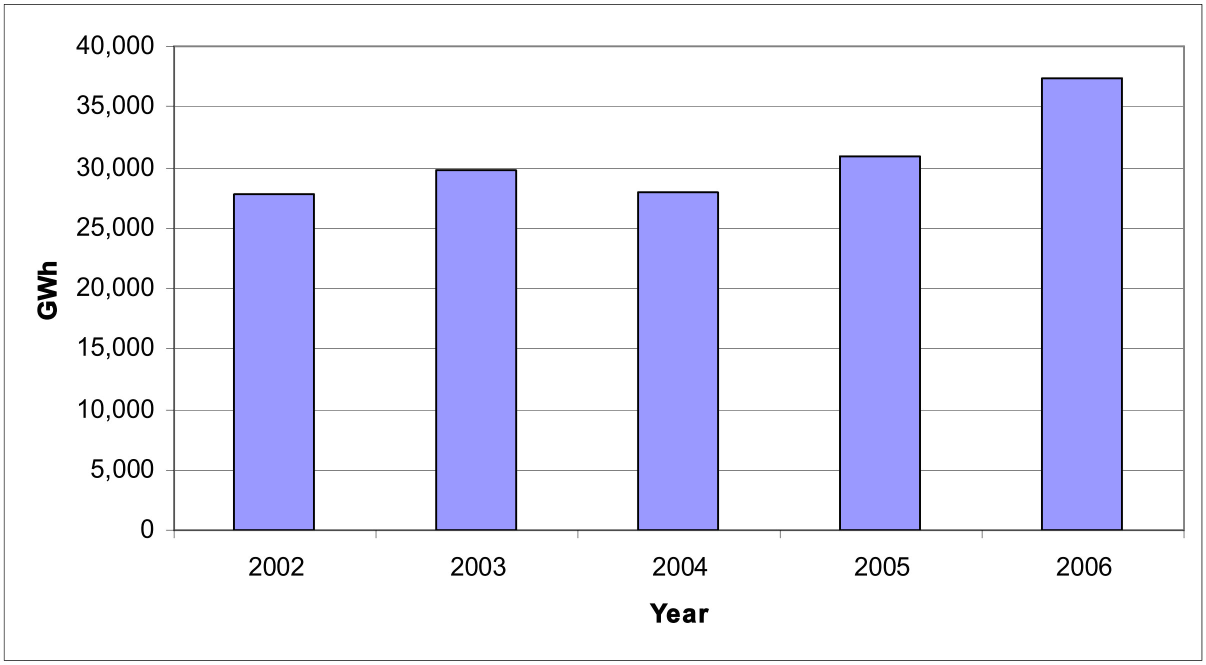
Generation units that are certified for providing RU and OR are identified using the CAISO internal database, and their maximum capabilities for providing RU and OR are calculated using their historical bid quantities. Bid prices are assumed to be zero as a simplification to the MRTU DAM so that there will be no capacity pricing for the service and only the opportunity cost (of not selling A/S capacity as energy) of providing reserve is calculated during the optimization process.[17] In other words, the market would at least have to compensate the generation unit providing A/S for the profit forgone in the energy market.

4.5.3 Prediction of Hydroelectric Generation

Three hydro scenarios (wet, medium, and dry) will be simulated based on California's historical hydroelectric production data for the purpose of preparing DAM bids for hydro units. The chart below shows the hydroelectric production level of hydroelectric resources within the CAISO control area from 2002 through 2006.

[17] Non-zero A/S bid prices essentially reflect the desired additional compensation to cover, for example, the cost of operating generation unit at lower efficiency to provide reserve, i.e., a premium on top of opportunity cost for providing A/S.

Figure 1. Annual Total CAISO Hydroelectric Production



From Figure 1 we see that 2004 is a low hydroelectric production year, 2005 is a medium production year, and 2006 is a high production year.

After the low, medium and high hydro years are identified, a hydro daily production duration curve was constructed for each season and each year. The 95th percentile date was then determined in each season as the hydro scenario date for the actual 24-hour simulation. Table 5 summarizes the days identified for various load scenarios in each season.

Table 5. Selection of Typical Day for Seasonal Hydro Scenario

Hydro Scenario	Winter	Spring	Summer	Fall
High	3/23/2006	5/19/2006	7/3/2006	11/30/2006
Medium	3/30/2005	5/25/2005	7/7/2005	12/26/2005
Low	3/19/2004	4/15/2006	7/16/2006	12/13/2006

The identification of hydro scenarios is again solely for the purpose of preparing hydro generation bids, pump storage facility bids and inter-tie import/export bids. Simulating hydro generation units' optimal bids with regard to hydro resources' energy limits and other constraints is beyond the scope of this study. In the section below we will discuss how we construct bids for hydro generation units that reasonably reflect hydrology conditions as well as the opportunity cost of hydro production.

CAISO control area import and export patterns are highly affected by the hydrology conditions not only within California, but in the Pacific Northwest as well. Hydrology conditions can be consistent across the West Coast, and in the CAISO control area inter-tie bids are generally correlated with hydro scenarios. In the next section we will also discuss how we construct inter-tie import and export bids that are consistent with the hydro condition in the West Coast.

4.5.4 Internal Supply

Supply can be broken out into the following categories: gas fired non-peaking generation, peakers, nuclear, hydroelectric/pump storage units, and qualifying facilities (i.e. wind, solar, geothermal, biomass, and cogeneration).[18]

4.5.5 Gas Fired Non-peaking Generation

The model contains 115 thermal units with installed capacity of roughly 26,000 MW, including new generation that has come online over the past few years. In the CPA simulations, all gas fired non-peaking units bid their marginal cost (plus an adder for variable operating and maintenance cost) as determined by the unit's heat rate and natural gas prices. The incremental heat rates are calculated from latest average heat rate data stored in the CAISO master file database. The "Option 2 cap with average heat rate" method is adopted in incremental heat rate calculation.[19] Other unit characteristics that are included in the economic dispatch process are minimum stable level, start-up cost, minimum up and down time, and maximum ramp up and ramp down rates. Gas fired non-peaking generation units are fully optimized in terms of a 24-hour unit commitment and hourly economic dispatch.

The minimum stable level, heat rate, start-up cost, minimum up/down time, and ramping rates for these units are all obtained from the CAISO internal database and the gas price forecast is obtained from 2006 historical data and will be discussed in a later section.

4.5.6 Peakers

There are 63 peaking generation units included in the model with total installed capacity roughly 3,000 MW. Similar to thermal units, all peakers are assumed to bid their marginal cost for energy, start-up cost for unit commitment, and the following physical operation parameters as reported to the CAISO: minimum up/down time, and maximum ramp up/down rate. Peakers are also fully optimized in terms of a 24-hour unit commitment and hourly economic dispatch.

4.5.7 Nuclear

There are four nuclear generating units (two San Onofre units and two Diablo Canyon units) included in the model with installed capacity of 4,450 MW. Bid quantities for nuclear resources are based on actual metered output for selected load scenario dates described in Table 3. The bid price for nuclear resources is $0/MWh. Unit commitments for nuclear resources are predefined according to their actual metered output and are not determined by the simulation software.

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[18] RMR and RA resources are treated the same as other resources for purposes of this analysis.

[19] More information about this method can be found at http://www.caiso.com/1ba0/1ba0885c5fea0.pdf

4.5.8 Hydroelectric Generation and Pump Storage Units

There are 197 hydroelectric resources included in the model.

Hydroelectric resources are committed and dispatched by the simulation software in the CPA. Bids are determined by two factors for these resources. First, the resource's final hour-ahead schedule for the chosen hydro scenario date in Table 5 is used to create the first bid segment at a price of $0/MWh. Second, the resource's real-time offer quantity is used for the second step of the bid curve, with the bid price for this second step calculated as the quantity-weighted average bid price from bids for that resource on the selected hydro scenario date. The two segments are combined together to form the final bidding quantity and price for hydro units. If a hydro unit has neither hour-ahead schedule nor real-time bids in the historical data for the identified hydro scenario year, no capacity is offered by that resource in the simulation.

Five pump storage units are considered in the model.

The generation of each of the pump storage units is already included in the hydro units' offer quantity/offer prices, as described above. The load side of the pump storage units is modeled as an energy purchaser in the simulation software, or, in effect, as load resources that buy energy from the pool. Each pump storage unit has a 2-step demand curve. For the first step of the demand curve, bid quantity is calculated as the final historical hour-ahead load schedule with a $5,000/MWh bid price which makes this bid segment a price-taking load bid segment. The second step of the pump-load bid curve has total real-time historical bid quantity for the quantity portion and the quantity-weighted average bid price for the price component. Similar to hydro units, if a pump storage unit does not have historical data for the identified hydro scenario years, that resource will not be bid into the simulation model.

4.5.9 Qualifying Facilities

Qualifying Facilities (QF) include wind, solar, geothermal, biomass, and co-generation units. Basically all the remaining internal units fall into this category. All QF units are assumed to bid in their actual 2006 (metered) generation level with zero price (i.e., self schedule). The same load scenario dates are used to construct their self-schedules.

4.5.10 Imports and Exports

Imports are not considered pivotal in this analysis: that is, no import resources are removed in any of the CPA simulation runs. External resources are modeled using their historical inter-tie bids at various scheduling tie-points. A tie-point connects a node inside the CAISO to a node outside of the CAISO. Each tie-point's outside node is considered to be both a generation node (for the purpose of modeling imports to the CAISO) and a load node (for the purpose of modeling exports from the CAISO). The imports are modeled as generators and the exports as purchasers (demand bids) in PLEXOS models.

Since hydro conditions and imports/exports are highly correlated, inter-tie bids are constructed using actual data from the specific hydro scenario dates. A multi-step bid curve is established for imports and exports across each tie-point separately using the approach described for hydroelectric resources (imports) and pump load (exports). Since more than one Scheduling Coordinator can submit their bids on each tie-point, all the historic hour-ahead schedules and real-time bids are grouped on the tie-point level and uniformly divided into a standard 11-segment format according to the aggregated price curve. Note that the $5,000/MWh price is to ensure self-scheduled export will be dispatched in the simulation.

Most of the tie-points in the CRR FNM also exist in the current RTMA system. Only a few tie-points have had name changes with the new CRR FNM release. In these cases, adjustments were made to the historical import bids to match the historical footprint to the new FNM footprint. For new tie-points which are not in the current system, no bids/offers are modeled. Note that despite having to make adjustments in schedule/bid origin or destination, the total quantity available across an interface or logical grouping of interfaces within a region remains the same as found in the historical data so that no import capability is lost in these adjustments.

4.5.11 Dynamic Schedules

Dynamic schedules are modeled in the same fashion as hydroelectric resources. There are a total of 12 dynamic units modeled in the system.

Table 6. Dynamic Scheduling Units

Dynamic Resource Name
APEX_2_MIRDYN
BCTSYS_5_PWXDYN
BLYTHW_1_APSDYN
DWPHOV_2_HOOVER
FCORNR_5_SCEDYN
HOOVER_2_VERDYN
MALIN_5_BPADYN
MRCHNT_2_MELDYN
MSQUIT_5_SERDYN
NGILAA_5_SDGDYN
PVERDE_5_SCEDYN
SCEHOV_2_HOOVER

4.6 Generation Ownership

This study focuses specifically on the impact of withdrawn capacity by the five largest owners in the CAISO control area who are net sellers and have an installed generator capacity over 1,000 MW with the consideration of tolling agreement adjustments. Note that the CPA considers only net sellers in the selection of potentially pivotal supplers since net buyers are less likely to benefit from increasing prices through withholding supply.

In order to accurately represent supplier's portfolios in CPA study, the CAISO adjusted the installed capacity portfolios of existing suppliers to account for transfers of operational and bidding control via tolling contracts. The CAISO surveyed suppliers having an installed capacity portfolio greater than 1,000 MW (the potentially pivotal suppliers considered in the last analysis) to collect data regarding tolling contracts that were in effect during the 2008 MRTU period and subsequently requested the same information from the named counterparties in a follow-up survey for verification. The CAISO verified these contractual arrangements itemized by both parties. A validated contractual arrangement was the one where both counterparties have independently itemized the same arrangement on their surveys.

There were five companies with an adjusted installed capacity over 1,000 MW. The adjusted capacity portfolios are listed in Table 7.

Table 7. Suppliers Considered and Their Generation Capacity Concentration, Adjusted for Tolling Agreements, by Zone

Supplier	CAISO Zone	Adjusted Installed Capacity (MW)	Percent of Zonal Capacity
S1	NP26	4,182	15%
	SP26	751	3%
S2	SP26	2,582	10%
S3	NP26	600	2%
	SP26	1,755	7%
S4	NP26	1,185	4%
	SP26	15	0%
S5	NP26	1,036	4%

The seven largest net suppliers were surveyed regarding tolling agreements in effect during the 2008 MRTU period, and the CAISO received survey responses from six of those seven suppliers. A total of 33 tolling contracts, representing 8,277 MW of installed capacity, were itemized by suppliers in their survey responses and verified by itemized contracts from the named counterparties.

The top three suppliers in terms of adjusted installed capacity in the NP26 area are S1 , S4 and S5. The top three suppliers in the SP26 area are S2, S3 and S1. For the CPA study, the FI values are calculated for candidate paths for all combinations of up to three of these five suppliers, where the capacity of the supplier combinations is removed from the simulation model either individually or jointly. The total number of supplier combinations (for capacity withheld) for any one season, load scenario, and hydro production scenario is 26 ($C^1_5 + C^2_5 + C^3_5 + 1 = 26$), which includes the base case with no suppliers withdrawn.

For each season, there are three load scenarios and three hydro scenarios. The total number of simulation runs for each season is 234 (26 supplier combinations * 3 load scenarios * 3 hydro production scenarios = 234).

For this release of CPA results, all four seasons are evaluated. The total number of simulation runs is 936 (4 seasons * 234 simulation runs per season = 936).

4.7 Natural Gas Prices

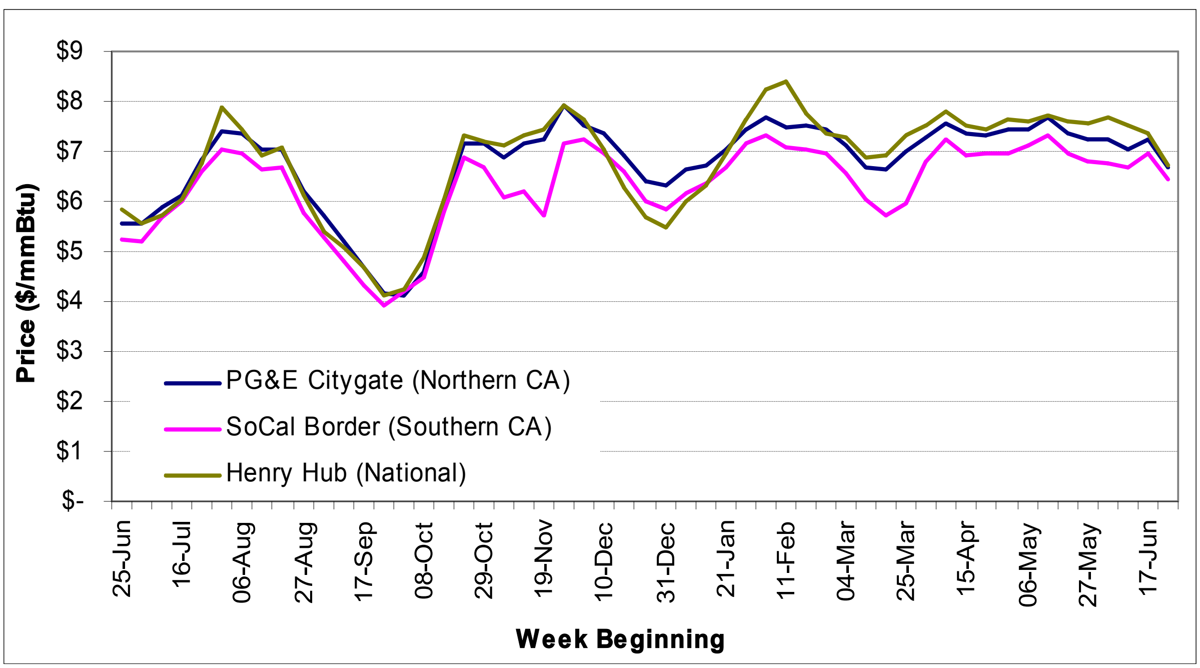
Natural gas prices are required to calculate the cost-based bids for thermal resources which have heat rate data in the CAISO master file database. The values used in the simulations for this CPA are seasonal average natural gas prices for the northern and southern regions of the CAISO control area from July 2006 to June 2007.

Table 8. Seasonal Natural Gas Prices by PTO Region

Season	PG&E	SCE	SDG&E
Winter	$7.07	$6.55	$6.55
Spring	$7.31	$6.92	$6.92
Summer	$6.09	$5.75	$5.75
Fall	$6.65	$6.16	$6.16

The following chart shows the actual nominal natural gas price in the CAISO control area for the 2006-2007 period.

Figure 2. Weekly Average Natural Gas Prices from July 2006 to June 2007



4.8 Generation and Transmission Outages

For this preliminary study, we assume all thermal and peaking units are available for energy and A/S commitment and dispatch between Pmin and Pmax, subject to minimum up/down time and ramp rates as well as the certified A/S capacity. In other words, planned and forced generation outages are not modeled for thermal and peaking units. The availability of all hydro units and QF units are determined either by their historic hour-ahead schedule level plus real-time bid level, or determined by the historic production level, thus they may incorporate a historical pattern of planned and forced outages to some degree.

Incorporation of transmission outages has been limited in this preliminary study and the status of transmission lines/transformers are kept consistent in this study with the CRR FNM.

4.9 Identification of Candidate Competitive Paths

In evaluating whether or not paths are competitive, we focus on the subset of all transmission paths for which this designation is most likely to impact market outcomes. The criteria for identifying candidate competitive paths, i.e., those that will be tested in this assessment, focuses on the frequency of real-time operational mitigation that has occurred in the most recent 12 months of operation. For the set of path designations that will be made prior to implementation of MRTU, the metrics for real-time operational mitigation are real-time Reliability Must Run (RMR) dispatches and real-time out-of-sequence (OOS) dispatches.

For real-time operational mitigation using RMR resources, data was collected reflecting resources that received real-time RMR dispatch instructions over the period July 1, 2006, through June 30, 2007. For any hour where an RMR dispatch was made to a specific resource, that hour was counted toward all lines that are mitigated using that RMR resource as identified in the CAISO Operating Procedures. The line/resource relationships identified in the CAISO Operating Procedures were used to create the specific mapping to credit each hour of real-time RMR dispatch of a specific resource to an hour of operational mitigation for a specific line or path. The general regions that are frequently mitigated using RMR resources are: San Francisco & Greater Bay Area, North Geysers, Palermo – Rio Oso, and San Diego Area.

For out-of-sequence dispatches, operator log entries were used to identify the reason for each individual OOS dispatch, and in cases where the reason did not include a specific line or lines, transmission operating procedures were used to map the resource to a specific set of transmission facilities. As with the real-time RMR dispatches, any hour where a resource was dispatched out-of-sequence in real time was credited toward an hour of operational mitigation for all lines for which that resource was identified as providing operational mitigation unless a specific subset of those lines was identified in the operator log for that particular OOS dispatch.

The mitigation information resulting from this mapping of resource-specific real-time RMR and OOS dispatch to transmission lines was combined to calculate the number of hours each identified transmission facility was mitigated during the twelve months ending June, 2007.

The following intra-zonal interfaces and individual transmission lines that are not part of any predefined interface/constraints had greater than 500 hours of real-time mitigation and consequently have been identified as candidate competitive paths.

Table 9. Candidate Competitive Paths that are Predefined Constraints

Operating Procedure	Zone	Constraint	Maximim Mitigation Hours for Qualification
T-126	NP26	Monta Vista - Jefferson	1,631
T-126	NP26	Ravenswood to San Mateo	1,631
T-133	NP26	Contra Costa 230kV Import	570
T-133	NP26	Moss Landing to Metcalf	570
T-133	NP26	Pittsburg (XFMR)	562
T-133	NP26	Pittsburg to San Mateo E. Shore	562
T-133	NP26	Ravenswood Cutplane	570
T-133	NP26	Tesla Banks 4 & 6	570
T-133	NP26	Tesla to Delta Switchyard	588
T-133	NP26	Tesla to Pittsburg	563
T-133	NP26	Vaca Bank & Tesla Bank 6	570
T-138	NP26	Humboldt Constraint and Banks	7,611
T-132	SP26	ElCentro 230/161 kV Bank	2,599
T-132	SP26	Imperial Valley Bank	2,599
T-132	SP26	Miguel 500/230 kV Banks	2,599
T-132	SP26	Miguel Max Import Constraint	2,599
T-132	SP26	San Diego Import (LNXFMR)	2,599
T-132	SP26	SDG&E CFE Import	2,599
T-132	SP26	Victorville-Lugo (HA-NG)	2,599
T-137	SP26	Serrano Bank	807
T-144	SP26	South of Lugo	1,253
T-159	SP26	Vincent Bank	1,077

Table 10. Candidate Competitive Paths that are Members of Predefined Constraints in NP26[20]

Operating Procedure	Zone	Constraint	Line	Maximim Mitigation Hours for Qualification
T-126	NP26	Monta Vista - Jefferson	Monta Vista - Jefferson #1 and #2 230kV Lines	1,631
T-126	NP26	Ravenswood to San Mateo	Ravenswood - San Mateo #1 and #2 230kV Lines	1,631
			Ravenswood - San Mateo 115kV Line	1,631
T-133	NP26	Contra Costa 230kV Import	[30580_ALTMID 1_230_30625_TESLA 5_230_1_CKT]	570
			Vaca 500/230kV Bank #11 Onto Tesla 500/230kV Bank #6	570
T-133	NP26	Moss Landing to Metcalf	[36221_MOSSLD 2_18_30780_MOSSLD10_230_1_CKT]	566
			[36222_MOSSLD 3_18_30780_MOSSLD10_230_1_CKT]	566
			[36223_MOSSLD 6_18_30780_MOSSLD10_230_1_CKT]	566
			[36224_MOSSLD 4_18_30787_MOSSLD12_230_1_CKT]	566
			[36225_MOSSLD 5_18_30787_MOSSLD12_230_1_CKT]	566
			[36226_MOSSLD 7_18_30787_MOSSLD12_230_1_CKT]	566
			Moss Landing-Metcalf #1 OR #2 230KV	570
			Moss Landing-Metcalf #1 & #2 230kV Line	566
			Moss Landing-Metcalf 500kV Line	570
T-133	NP26	Pittsburg (XFMR)	[32950_PITTSP 2_115_30527_PITTSP 5_230_1_CKT]	562
			[32950_PITTSP 2_115_30527_PITTSP 5_230_2_CKT]	562
T-133	NP26	Pittsburg to San Mateo E. Shore	[30527_PITTSP 5_230_99100_PITTSP 7_230_1_CKT]	562
			[30527_PITTSP 5_230_99102_PITTSP 6_230_1_CKT]	562
T-133	NP26	Ravenswood Cutplane	[30630_NEWARK 3_230_30703_RAVENS 2_230_1_CKT]	570
			[35349_AMES 2_115_35122_NEWARK 1_115_1_CKT]	570
			Tesla - Ravenswood 230KV Line	570
T-133	NP26	Tesla Banks 4 & 6	Tesla 500/230kV Banks #4 Onto #6	570
			Tesla 500/230kV Banks #6 Onto #4	570
			Vaca 500/230kV Bank #11 Onto Tesla 500/230kV Bank #6	570
T-133	NP26	Tesla to Delta Switchyard	Delta Sw Yd - Tesla 230kV Line	588
			Delta Switchyard - Tesla 230KV Line	570
			Delta Switchyard - Tesla 230kV Line	570
T-133	NP26	Tesla to Pittsburg	Pittsburg - Tesla #1 & #2 230kV Lines	563
			Pittsburg - Tesla #1or #2 230 kV	563
T-133	NP26	Vaca Bank & Tesla Bank 6	Vaca 500/230kV Bank #11 Onto Tesla 500/230kV Bank #6	570
			Vaca Dixon 500/230KV Bank #11	570
T-138	NP26	Humboldt Constraint and Banks	[31093_GRSCRK 2_60_31092_MPLCRK 1_60_1_CKT]	7,611
			[31116_GARBVL 1_60_31118_KEKAWK 1_60_1_CKT]	7,611
			Bridgeville - Cottonwood 115 kV Line	7,611
			Humboldt - Trinity 115 kV Line	7,611
			Humboldt 115/60 kV Bank #1	7,611
			Humboldt 115/60 kV Bank #2	7,611

[20] Line names that are bracketed indicate a physical line or line segment in the CRR full network model that were within the network sub-region identified in a CAISO Operating Procedure or were directly associated with the lines identified in the CAISO Operating Procedure but did not have a more routine naming convention. The naming convention used for these lines follows the naming convention used by the simulation software and contains terminus bus numbers as well as voltage.

Table 11. Candidate Competitive Paths that are Members of Predefined Constraints in SP26[21]

Operating Procedure	Zone	Constraint	Line	Maximim Mitigation Hours for Qualification
T-132	SP26	ElCentro 230/161 kV Bank	[22356_IVALLY 1_230_21025_ELCNTO 1_230_1_CKT]	2,599
			North Gila - Imperial Valley (50002)	2,599
T-132	SP26	Imperial Valley Bank	Imperial Valley 500/230 kV Bank 80 or 81	2,599
T-132	SP26	Miguel 500/230 kV Banks	[22356_IVALLY 1_230_22994_TERMEX 1_230_1_CKT]	2,599
			[22356_IVALLY 1_230_22994_TERMEX 1_230_2_CKT]	2,599
			[22464_MIGUEL 1_230_22468_MIGUEL 3_500_1_CKT]	2,599
			[22468_MIGUEL 3_500_22472_MIGUEL 4_1_1_CKT]	2,599
			Imperial Valley - La Rosita 230 kV	2,599
T-132	SP26	Miguel Max Import Constraint	[22464_MIGUEL 1_230_22468_MIGUEL 3_500_1_CKT]	2,599
			[22468_MIGUEL 3_500_22472_MIGUEL 4_1_1_CKT]	2,599
			Miguel - Tijuana 230 kV line	2,599
T-132	SP26	San Diego Import (LNXFMR)	[22464_MIGUEL 1_230_22468_MIGUEL 3_500_1_CKT]	2,599
			[22468_MIGUEL 3_500_22472_MIGUEL 4_1_1_CKT]	2,599
			Miguel - Tijuana 230 kV line	2,599
			SONGS - San Luis Rey	2,599
			SONGS - Talega	2,599
T-132	SP26	SDG&E CFE Import	[22356_IVALLY 1_230_20118_ROA 1_230_1_CKT]	2,599
			Imperial Valley - Miguel (50001)	2,599
			SONGS - San Luis Rey	2,599
			SONGS - Talega	2,599
T-132	SP26	Victorville-Lugo (HA-NG)	[24086_LUGO 5_500_26105_VICTVL 1_500_1_CKT]	2,599
			Hassayampa - North Gila (HAA-NG)	2,599
T-137	SP26	Serrano Bank	[24138_SERRAN 1_500_24184_SERRAN 2_1_1_CKT]	807
			[24138_SERRAN 1_500_24186_SERRAN 3_1_1_CKT]	807
			Serrano 500/220 kV AA Bank 1AA	807
T-144	SP26	South of Lugo	Lugo - Mira Loma 500kV Lines	1,253
T-159	SP26	Vincent Bank	Vincent 1AA 500/220 Transformer Bank	1,077
			Vincent 2AA 500/220 Transformer Bank	1,077
			Vincent 3AA 500/220 Transformer Bank	1,077

[21] See footnote 20.

Table 12. Summary List of Candidate Competitive Paths that are Individual Lines in NP26

Operating Procedure	Zone	Line	Maximim Mitigation Hours for Qualification
T-126	NP26	AHW-1 & -2 115kV Cables (Martin - Bayshore - Potrero)	1,631
T-126	NP26	AP-1 115kV Cable (Potrero - Hunters Point)	1,631
T-126	NP26	AX 115kV Cable (Potrero - Mission)	1,631
T-126	NP26	AY-1 & -2 115kV Cables (Potrero - Larkin)	1,631
T-126	NP26	East Grand - San Mateo & Martin - East Grand 115kV Lin	1,631
T-126	NP26	Eastshore - San Mateo 230kV Line	1,631
T-126	NP26	HP-1 & -3 115kV Cables (Martin - Hunters Point)	1,631
T-126	NP26	HY-1 115kV Cable (Martin - Larkin)	1,631
T-126	NP26	Jefferson - Martin 230kV Cable	1,631
T-126	NP26	Martin - Embarcadero 230kV #1 and #2 Cables	1,631
T-126	NP26	Martin 230/115kV Transformer Banks #7 and #8	1,631
T-126	NP26	Millbrae - San Mateo #1 & Martin - Millbrae 115kV Line	1,631
T-126	NP26	Monta Vista - Jefferson #1 and #2 230kV Lines	1,631
T-126	NP26	Pittsburg - San Mateo 230kV Line	1,631
T-126	NP26	PX-1 & -2 115kV Cables (Hunters Point - Mission)	1,631
T-126	NP26	San Mateo - Belmont 115kV Line	1,631
T-126	NP26	San Mateo - Martin #3 115kV Line	1,631
T-126	NP26	San Mateo - Martin 230kV Cable	1,631
T-126	NP26	San Mateo 230/115kV Transformer Banks #5, #6 and #7	1,631
T-126	NP26	SF Airport - San Mateo & Martin - SF Airport 115kV Lin	1,631
T-126	NP26	XY-1 115kV Cable (Larkin - Mission)	1,631
T-133	NP26	Ignacio (Crock Tap) - Sobrante 230KV Line	558
T-133	NP26	Kelso - Tesla 230KV Line	563
T-133	NP26	Lakeville-Sobrante #2 230KV Line	558
T-133	NP26	Metcalf 500/230KV Bank #11	570
T-133	NP26	Metcalf 500/230KV Bank #12	570
T-133	NP26	Metcalf 500/230KV Bank #13	570
T-133	NP26	Moss Landing 500/230KV Bank #9	570
T-133	NP26	Pittsburg - Eastshore 230KV Line	562
T-133	NP26	Pittsburg - San Mateo 230kV Line	1,224
T-133	NP26	Tesla - Newark #1 230KV line	570
T-133	NP26	Tesla - Tracy #1 OR #2 230KV Lines	570
T-133	NP26	Tesla 500/230KV Bank #2	570
T-133	NP26	Tracy 500/230KV Banks KT1A OR KT2A	570
T-133	NP26	Vaca Dixon - Bahia 230KV Line	563
T-133	NP26	Vaca Dixon - Lambie Sw Sta 230kV Line	551
T-133	NP26	Vaca Dixon - Parkway 230KV Line	559
T-133	NP26	Vaca Dixon - Peabody 230kV Line	551
T-138	NP26	Bridgeville - Garberville 60 kV	7,611
T-138	NP26	Humboldt - Maple Creek 60 kV Line	7,611

Table 13. Summary List of Candidate Competitive Paths that are Individual Lines in SP26

Operating Procedure	Zone	Line	Maximim Mitigation Hours for Qualification
T-132	SP26	Encina - Penasquitos	2,599
T-132	SP26	Miguel - Mission Line 1 or 2	2,599
T-132	SP26	Miguel - Old Town	2,599
T-132	SP26	Miguel - Sycamore Canyon 1 or 2	2,599
T-132	SP26	Mission - Old Town	2,599
T-132	SP26	Mission - San Luis Rey	2,599
T-132	SP26	Palomar - Escondido	2,599
T-132	SP26	Penasquitos - Old Town	2,599
T-132	SP26	San Luis Rey - Encina	2,599
T-132	SP26	San Luis Rey - Encina - Escondido	2,599
T-132	SP26	Sycamore - Palomar	2,599
T-132	SP26	Talega - Escondido	2,599
T-175	SP26	Devers AA Xfmr	1,004
T-175	SP26	Devers-San Bernardino #1 220 kV Line	1,004
T-175	SP26	Devers-Vista #1 220 kV Line	1,004

4.10 Simulation Process

Once model parameters (discussed above) are determined, a 24-hour unit commitment and hourly economic dispatch can be simulated for the typical day in each season under various scenarios discussed above, subject to a set of transmission constraints: hard transmission constraints on grandfathered paths, and soft constraints on all transmission lines/transformers/local area constraints that are not grandfathered. The model assumes each resource is available at its minimum load or greater and is available to be dispatched up or shut down in the initial hour of the simulation. The optimization engine chooses the best unit commitment/economic dispatch for the next 24 hours. The same process is repeated until all seasons, all scenarios, and all potentially pivotal supplier combinations are exhausted. For each simulation run that addresses withheld capacity, we remove the physical generating resources controlled by the suppliers considered from the simulation model and clear load based on the seasonal base case of load and hydro scenarios. We take the power flow results from the simulation model and calculate the FI for candidate paths using the line limits and flows from the output. For this release of CPA results, we present results for all load and hydro production scenarios and most supplier combinations for all four seasons.

5 Demonstration of Competitive Path Assessment

As stated above, typical days in four seasons are picked for the preliminary competitive path analysis. For each typical day, various potentially pivotal supplier combinations are evaluated for each of the nine load and hydro scenarios. In the following section, we first present the hourly system conditions for the base case, medium load and medium hydro scenario in the Spring without any suppliers' capacity removed. Next, we present FI results for the high load, low hydro scenario for all 26 supplier combinations for removed capacity for spring, and finally the results for all 234 load and hydro scenarios and supplier combinations for spring. The same is repeated for the summer, fall and winter seasons. Please note that since only the supplier portfolios for withholding scenarios are different from those used in the last set of preliminary results, the base case results (no suppliers withheld) are exactly the same as in Release 2.

As noted in Section 4.9 on identification of candidate paths, there are separate categories of "candidate paths" considered in this analysis: broader aggregate (sub-regional) constraints that contain one or more individual line segments (Table 9), the line segments that comprise the broader constraints (Table 10 and Table 11), and independent line segments that are not specifically associated with any broader constraint (Table 12 and Table 13). All three categories of candidate paths are tested in this analysis. In the case of broader aggregate constraints comprised of individual line segments, these components are tested separately; however, if any element (broader constraint or any individual line segment that composed the broader constraint) fails the competitiveness test, all associated elements fail the competitiveness test. Otherwise, the broader constraint and all its associated individual line segments pass the competitiveness test. For individual independent line segments, they are tested separately and pass or fail based on that test.

Since no individual candidate paths failed the test, the FI results tables in this section show only the FI results for aggregated candidate paths.

5.1 Spring Season Results

5.1.1 Base Case Results

The base case results for spring are presented in Table 14 below for medium load, medium hydro, and no supplier capacity withdrawn. General simulation characteristics are presented including load, zonal average Locational Marginal Prices (LMPs), total generation internal to the CAISO, net import values,[22] and internal path flows (Path 15 and Path 26) for each of the 24 hours of the spring medium load medium hydro base case.

[22] The net imports from the Northwest (NW) are calculated as the sum of Cascade, PACI, PDCI and Summit Branch Groups. The net imports from the Southwest (SW) are calculated as the sum of Adelanto and Victorville Market Scheduling Limits (ADLNTOVICTVL-SP_MSL), Fourcorner Branch Group, Palo Verde Branch Group and CFE Branch Group.

Table 14. Base Case: Model Output for Spring, Medium Hydro, Medium Load, and No Supply Withdrawn

	Load (MWh)		Price ($/MWh)		Generation (MWh)		Net Import		Internal Path Flow (MWh)	
Hour	NP26	SP26	NP26	SP26	NP26	SP26	NW	SW	P15 (S->N)	P26 (S->N)
1	10,919	13,734	$54.89	$46.76	10,828	7,413	3,313	3,395	-810	-2,947
2	10,686	12,965	$56.61	$48.30	10,809	7,715	1,993	3,400	-532	-2,694
3	10,664	12,382	$56.16	$48.57	11,175	7,600	1,524	3,359	-211	-2,380
4	10,435	12,049	$56.32	$45.70	10,724	7,252	1,764	3,340	-2	-2,169
5	10,402	11,909	$54.71	$41.66	10,474	7,015	2,056	3,306	204	-1,896
6	10,288	11,542	$51.27	$24.94	10,276	6,658	1,679	3,110	876	-1,231
7	10,674	11,973	$63.15	$32.14	10,524	6,937	3,121	3,268	766	-1,328
8	10,833	13,183	$61.65	$38.10	10,741	7,091	3,155	3,364	849	-1,347
9	11,454	14,697	$56.41	$45.04	11,465	7,178	3,461	3,385	450	-1,830
10	12,164	16,247	$55.50	$49.54	12,442	7,752	3,785	3,436	-333	-2,578
11	12,702	17,725	$61.81	$51.99	13,219	8,360	4,136	3,295	-283	-2,845
12	13,103	18,860	$65.26	$54.84	14,066	9,186	4,152	3,291	-239	-3,060
13	13,466	19,678	$65.43	$58.72	14,927	10,239	3,957	3,480	-406	-3,281
14	13,694	20,446	$69.08	$62.45	14,890	11,147	3,958	3,902	-319	-2,928
15	13,944	20,888	$73.02	$62.84	14,893	11,691	4,442	3,989	-157	-2,630
16	14,102	21,122	$74.10	$63.55	15,229	11,883	4,247	3,928	-325	-2,779
17	14,181	21,181	$74.09	$65.57	15,482	12,151	3,974	3,960	55	-2,446
18	14,150	20,752	$72.62	$62.35	15,520	11,676	4,089	3,935	-84	-2,896
19	13,811	19,884	$69.09	$60.24	14,805	10,755	4,296	3,804	-392	-3,043
20	13,356	19,188	$62.96	$57.68	14,255	9,838	4,373	3,754	-838	-3,508
21	13,769	19,280	$68.72	$59.11	14,997	9,802	4,049	3,541	-545	-3,700
22	12,966	17,775	$60.80	$54.28	14,149	8,580	3,709	3,561	-825	-3,700
23	11,682	15,656	$55.95	$48.46	11,540	7,668	4,027	3,445	-827	-3,050
24	10,979	14,024	$54.19	$41.31	10,691	7,382	3,789	3,115	69	-1,935

The load-weighted zonal LMPs for both NP26 and SP26 are below $75/MWh throughout the simulated day, which reflects a relatively abundant supply of efficient supply system-wide. The NP26 area is a net importer during the morning ramping hours when inexpensive imports are more available from the Northwest. As the load grows, NP26 internal generation can meet all of its load and even provide relatively small amount of export. The SP26 area is a net importer throughout the day with the largest import volume (the difference between load and generation) above 9,600 MW in hour 12. The power flows on the internal paths are from north-to-south (from ZP26 into SP15) for Path 26 all day long. Flows on Path 15 are from south-to-north (ZP26 to NP15) during the morning ramping hours and from north-to-south for most of the afternoon and evening peak hours, which are normal flow directions in spring. Path 26 is binding from north-to-south for hours 21 and 22 with a hard limit of 3,700 MW seasonal limits. The total imports into the CAISO control area are roughly 4,000 MW from the Northwest during most of the peak hours and are between 3,000 MW and 4,000 MW from the Southwest throughout the day. The base case results are characteristic of actual operating conditions observed during the spring season.

Limits and hourly flows for existing Branch Groups for the spring, medium load, medium hydro base case are shown in Table 15.

Table 15. Base Case: Branch Group Flows for Spring, Medium Hydro, Medium Load, and No Supply Withdrawn

Branch Group	Min Limit	Max Limit	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
ADLANTOSP_MSL	-502	1036	465	464	463	464	464	462	491	489	495	423	443	462	444	453	528	453	438	446	478	467	473	473	448	462
ADLNTOVICTVL-SP_MSL	-1061	2561	736	736	686	686	689	692	660	668	673	636	662	664	609	620	699	624	616	615	647	636	640	640	631	691
BLYTHE_BG	-153	216	10	10	10	10	10	10	23	104	106	110	114	117	119	121	123	124	124	123	120	118	118	114	109	13
CAPTAINJACK_BG	-79	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPTAINJACK_MSL	-1446	1417	280	536	393	158	-163	-378	63	-33	-199	275	-148	-534	-326	-353	-655	-695	-777	-490	-290	-253	-276	95	142	-569
CASCADE_BG	-45	78	0	0	0	0	0	0	0	0	0	0	78	78	78	78	78	78	78	78	78	78	0	0	0	0
CFE_BG	-408	800	75	75	75	75	75	75	84	99	113	122	87	87	212	168	88	137	137	88	88	88	87	87	162	75
CTNWDRDMT_BG	-370	363	-162	-115	-98	-117	-137	-128	-126	-134	-142	-123	-139	-148	-136	-142	-182	-175	-166	-164	-166	-182	-178	-148	-178	-201
CTNWDWAPA_BG	-1594	1562	12	115	127	71	15	4	54	28	17	103	-14	-47	-11	-33	-136	-118	-107	-86	-74	-98	-29	44	-33	-143
ELDORADO_BG	-1400	1372	909	909	910	909	911	804	819	826	856	754	757	822	806	929	1006	957	1116	987	905	891	826	826	841	819
FCORNER5SPTO_BG	-99999	99999	1030	1030	1030	1030	1030	855	890	890	940	890	860	888	860	1053	1094	1093	1092	1141	1011	990	890	890	910	880
FOURCORNER3_5XFMRBG	-99999	99999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONDIPPDC_BG	-51	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IID-SCE_BG	-100	588	492	492	492	519	512	512	583	528	493	493	493	493	493	493	493	493	493	493	493	493	493	493	493	493
IID-SDGE_BG	-225	221	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IPP-IPPGEN_BG	-9999	9999	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274	-274
IPPDCADLN_BG	-471	560	374	374	374	374	374	374	377	377	377	357	357	357	326	326	401	326	326	326	326	326	357	357	369	379
LAUGHLIN_BG	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLNLTESLA_BG	-164	161	25	25	25	24	23	18	41	20	22	29	36	40	43	44	42	35	33	33	32	27	28	25	20	18
MCCLMKTPC_MSL	-686	686	158	162	163	156	179	271	209	291	260	335	401	377	279	250	262	271	263	245	286	283	288	287	282	265
MCCULLGH_MSL	-2598	2546	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEADMKTPC_MSL	-369	369	126	126	126	126	129	132	132	140	145	103	129	144	145	156	160	160	152	151	183	172	145	145	126	126
MEADTMEAD_MSL	-182	182	0	0	0	0	3	6	6	14	19	19	36	24	19	30	34	34	26	25	57	46	19	19	0	0
MEAD_MSL	-1460	1431	656	680	699	670	745	942	598	864	747	1060	1226	1100	732	722	801	820	978	774	769	786	774	773	1015	938
MERCHANT_BG	-645	632	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MKTPCADLN_MSL	-423	423	126	126	126	126	129	132	147	155	160	118	144	159	160	171	175	175	167	166	198	187	160	160	126	126
MONAIPPDC_BG	-516	458	100	100	100	100	100	100	103	103	103	83	83	83	52	52	127	52	52	52	52	52	83	83	95	105
N.GILABK4_BG	-366	359	53	0	0	0	0	0	0	0	0	40	57	57	57	57	57	57	57	57	57	57	57	57	53	53
NOB_BG	-1465	2091	543	0	0	0	43	153	1331	1386	1560	1895	1973	1900	1957	1936	1947	1927	1927	1900	1900	1557	1436	1416	1037	934
OAKDLSBNS_BG	-425	417	164	128	76	72	66	-3	1	-10	-14	34	43	52	21	11	-5	16	-20	-14	34	88	65	126	152	96
PACI_UPPER_BG	-2450	3200	2701	1924	1455	1695	1944	1526	1790	1769	1901	1890	2084	2123	1871	1875	2366	2191	1918	2060	2318	2738	2613	2270	2921	2786
PALOVRDE_BG	-2532	2481	1554	1559	1568	1549	1512	1488	1634	1707	1659	1788	1686	1651	1799	2061	2108	2074	2115	2091	2058	2040	1924	1944	1742	1469
PARKER_BG	-60	216	12	12	12	12	12	12	41	41	91	171	171	171	171	186	186	186	186	186	186	171	171	171	20	12
PATH15_BG	-99999	5400	-810	-532	-211	-2	204	876	766	849	450	-333	-283	-239	-406	-319	-157	-325	55	-84	-392	-838	-545	-825	-827	69
PATH26_BG	-3700	99999	-2947	-2694	-2380	-2169	-1896	-1231	-1328	-1347	-1830	-2578	-2845	-3060	-3281	-2928	-2630	-2779	-2446	-2896	-3043	-3508	-3700	-3700	-3050	-1935
RNCHLAKE _BG	-1271	1246	219	241	265	255	245	233	176	62	63	104	214	274	186	149	53	165	163	60	74	78	141	163	174	149
SILVERPK_BG	-17	17	11	12	11	12	11	12	11	12	11	12	11	12	17	17	17	17	17	17	11	12	11	12	11	12
SUMMIT_BG	-100	69	69	69	69	69	69	0	0	0	0	0	0	50	50	69	50	50	50	50	0	0	0	23	69	69
SUTTEROBNION_BG	-1366	1339	0	0	0	0	0	0	0	0	0	0	0	-250	-250	-156	0	0	0	0	0	0	-162	-250	0	0
SYLMAR-AC_MSL	-1200	1176	62	59	59	59	62	62	62	62	110	62	110	110	112	112	112	112	112	112	112	112	111	111	63	63
TRACYPGAE_BG	-4388	4265	427	560	437	298	115	-61	145	81	34	344	136	-27	79	30	-217	-196	-275	-124	39	104	80	323	303	-144
TRACYPSDO_BG	-99999	99999	283	306	310	305	293	299	323	293	285	288	282	283	280	268	242	240	239	238	237	238	246	265	271	260
TSLASTDFD_BG	-425	417	-21	-6	18	16	14	48	62	73	69	57	47	30	46	51	60	48	67	71	51	25	41	5	-7	2
VICTVL_MSL	-560	1495	236	236	186	186	186	186	136	136	136	161	161	148	123	123	123	123	123	123	123	123	123	123	136	186
WSTWGMEAD_MSL	-126	126	126	126	126	126	126	126	126	126	126	84	93	120	126	126	126	126	126	126	126	126	126	126	126	126

5.1.2 FI Results

The FI summary results for spring low hydro, high load, and all 26 supplier combinations for withdrawn capacity are presented in Table 16. Candidate paths listed in the first column represent an aggregation of lines for that constraint set. More specifically, for certain constraints there is more than one physical facility (line, transformer) or simultaneous flow constraint that is associated. In these cases, the minimum FI value for all physical facilities and simultaneous flow constraints associated with the aggregate constraint is used as the FI value for that aggregate constraint for that hour. Where final path designations are made, the designation will apply to all physical facilities and simultaneous flow constraints associated with the aggregate constraint for which the designation is made.

The simulation is run for 24 hours, and in the case of spring low hydro, high load, 624 hours are simulated (24 hours * 26 supplier combinations). The second column is the minimum calculated FI value for that candidate path across all hours simulated. The third column shows the number of hours where the calculated FI was less than zero. The fourth column shows the percent of simulated hours where the calculated FI was less than zero.

The minimum FI value reported in the second column is interpreted as follows: the magnitude of the value indicates the proportion of the path limit that was exceeded by the simulated flow in order to solve the simulation with some combination of suppliers' capacity removed.

Please note that the results for all candidate paths that represent an aggregation of lines are presented in this section while only the failed candidate paths that represent a single transmission segment (line/transformer) are listed here to save space.

Table 16. FI Results for Spring - Low Hydro and High Load Scenarios

Candidate Path	Minimum FI	Hours w/ FI < 0	Percent of Hours w/ FI < 0
Contra Costa 230kV Import	-0.01	4	0.6%
ElCentro 230/161 kV Bank			
HUMBOLDT_BG			
Humboldt Bank			
Imperial Valley Bank			
MIGUEL_MAXIMP_LNXFMRBG			
Miguel 500/230 kV Banks			
Monta Vista - Jefferson	-0.02	3	0.5%
Moss Landing to Metcalf	-0.79	8	1.3%
PITSBRG_XFMRBG	-0.24	143	22.9%
Pittsburg to San Mateo_E. Shore			
Ravenswood Cutplane			
Ravenswood to San Mateo			
SDGEIMP_LNXFMRBG			
SDGE_CFEIMP_BG			
SOUTHLUGO_BG			
Serrano Bank			
Tesla Banks 4 & 6			
Tesla Banks 6 & 4			
Tesla to Delta Switchyard			
Tesla to Pittsburg			
Vaca Bank & Tesla Bank 6	-0.03	14	2.2%
Victorville-Lugo (HA-NG)			
Vincent Bank			

The most frequently violated candidate paths are PITSBRG_XFMRBG (Pittsburgh transformers) with negative FI values in 23% of simulated hours. The Contra Costa 230kV import, Monta Vista to Jefferson, Moss Landing to Metcalf and Vaca Bank and Tesla Bank 6 constraints also showed negative FI. For this set of simulation runs, nineteen candidate paths showed no instances of calculated negative FI values: ElCentro 230/161 kV Bank, HUMBOLDT_BG (Humboldt branch group), Humboldt Bank, Imperial valley Bank, MIGUEL_MAXIMP_LNXFMRBG (Miguel Max Imports), Miguel 500/230 kV Banks, Pittsburgh to San Mateo_E. Shore, Ravenswood Cutplane, Ravenswood to San Mateo, SDGEIMP_LNXFMRBG (SDGE imports), SDGE_CFEIMP_BG (SDGE-CFE imports), SOUTHLUGO_BG (South of Lugo), Serrano Bank, Tesla Banks 4 onto 6 and 6 onto 4, Tesla to Delta Switchyard, Tesla to Pittsburg, Victorville-Lugo (HA-NG) and Vincent Bank.

The FI summary results for all load and hydro scenarios and supplier withdrawn combinations in spring are presented in Table 17. The last column shows the seasonal competitive test results with a test threshold of zero hours with negative FI. A column value of “Fail” indicates that based on the FI values resulting from the simulation the candidate path failed the competitiveness test for that season. A blank value indicates the path did not have a negative FI in any of the simulated hours and consequently passed the seasonal competitiveness test.

Table 17. FI Results for Spring - All Load and Hydro Scenarios

Candidate Path	Minimum FI	Hours w/ FI < 0	Percent of Hours w/ FI < 0
Contra Costa 230kV Import	-0.01	8	0.1%
ElCentro 230/161 kV Bank			
HUMBOLDT_BG			
Humboldt Bank	-0.03	21	0.4%
Imperial Valley Bank			
MIGUEL_MAXIMP_LNXFMRBG			
Miguel 500/230 kV Banks			
Monta Vista - Jefferson	-0.02	3	0.1%
Moss Landing to Metcalf	-0.79	8	0.1%
PITSBRG_XFMRBG	-0.27	445	7.9%
Pittsburg to San Mateo_E. Shore			
Ravenswood Cutplane			
Ravenswood to San Mateo			
SDGEIMP_LNXFMRBG			
SDGE_CFEIMP_BG			
SOUTHLUGO_BG			
Serrano Bank			
Tesla Banks 4 & 6			
Tesla Banks 6 & 4			
Tesla to Delta Switchyard			
Tesla to Pittsburg			
Vaca Bank & Tesla Bank 6	-0.03	16	0.3%
Victorville-Lugo (HA-NG)			
Vincent Bank			

The results for all load and hydro scenarios and all 26 supplier combinations are similar to the high load, low hydro results presented in Table 16 except that the relative percent of hours with negative FI values for certain candidate paths is somewhat lower. This is expected, since Table 16 shows results for the most conservative set of system conditions where we expect supply to be relatively tight compared to the other load and hydro scenarios in the spring. Also one more candidate paths in the NP26 area, Humboldt Bank, failed when evaluated across all load and hydro scenarios, as compared to the low hydro and high load scenario alone.

For spring simulations, no load is curtailed in any scenario.

5.2 Summer Season Results

5.2.1 Base Case Results

The base case results for summer are presented in Table 18 below for medium load, medium hydro, and no supplier capacity withdrawn. General simulation characteristics are presented including load, average LMPs, total generation internal to the CAISO, net import values, and internal path flows (Path 15 and Path 26) for each of the 24 hours.

Table 18. Base Case: Model Output for Summer, Medium Hydro, Medium Load, and No Supply Withdrawn

	Load (MWh)		Price ($/MWh)		Generation (MWh)		Net Import		Internal Path Flow (MWh)	
Hour	**NP26**	**SP26**	**NP26**	**SP26**	**NP26**	**SP26**	**NW**	**SW**	**P15 (S->N)**	**P26 (S->N)**
1	11,956	15,587	$53.29	$46.07	13,469	9,590	1,239	3,759	836	-2,729
2	11,386	14,633	$52.55	$45.85	13,277	9,092	1,163	3,683	1,166	-2,415
3	11,354	13,939	$52.67	$45.72	13,251	9,197	824	3,613	1,736	-1,864
4	11,139	13,602	$51.23	$44.34	12,921	8,564	1,278	3,840	1,506	-2,081
5	11,121	13,543	$51.23	$44.35	12,898	8,326	1,124	3,770	1,381	-2,204
6	11,244	13,547	$51.23	$44.34	13,002	8,182	674	3,804	1,470	-2,089
7	11,636	14,119	$51.20	$44.42	13,582	8,150	2,742	3,723	1,667	-1,883
8	12,090	15,648	$52.06	$47.57	13,886	8,952	3,060	3,669	1,172	-2,309
9	12,726	17,564	$55.32	$50.24	14,378	10,079	2,969	3,861	791	-2,672
10	13,639	19,569	$57.07	$51.82	15,641	11,161	3,257	3,938	528	-2,927
11	14,340	21,178	$58.31	$53.25	16,218	12,427	3,460	4,146	1,025	-2,457
12	14,901	22,267	$63.44	$53.59	16,732	13,284	3,692	4,109	977	-2,225
13	15,432	23,282	$70.09	$54.80	17,443	14,349	3,842	4,057	262	-2,185
14	16,067	24,196	$76.65	$55.61	17,859	15,547	3,774	4,287	-449	-2,191
15	16,591	25,014	$106.01	$58.58	18,344	16,332	4,051	4,252	-1,116	-2,287
16	17,053	25,450	$162.68	$57.45	19,106	16,909	4,079	3,979	-1,646	-2,611
17	17,259	25,378	$322.51	$64.52	19,359	16,936	4,030	4,018	-1,920	-2,869
18	17,230	24,912	$188.38	$61.53	19,315	16,682	4,083	3,906	-1,846	-2,797
19	16,821	23,850	$115.44	$50.26	18,787	15,550	3,911	4,158	-1,311	-2,531
20	16,175	22,812	$75.33	$54.19	18,075	14,418	4,074	3,985	-1,082	-2,971
21	16,145	22,752	$71.82	$53.99	17,942	14,117	4,087	3,945	-1,020	-3,219
22	15,315	21,382	$65.71	$52.25	17,421	12,725	3,742	3,931	-17	-3,186
23	13,875	19,323	$57.01	$51.06	14,828	11,249	2,750	3,939	-5	-3,242
24	12,560	17,391	$55.58	$50.00	13,700	10,422	2,111	3,964	-110	-3,349

The load-weighted zonal LMPs for NP26 are under $80/MWh for most of the hours, except for the super-peak hours 15-19 where they range from $100/MWh to $325/MWh reflecting tight supply during high load system conditions and the need to dispatch much less efficient generation to meet load. The LMPs for SP26 remained relatively low throughout the peak hours, staying below $65/MWh across all hours. Internal path flows indicate north-to-south flows throughout the hours on Path 26, while flows on Path 15 shift to a north-to-south flow ranging from 1,000 MW to 2,100 MW during the super peak hours as loads in the South increase. The SP26 area is a net importer throughout the day. The total imports into the CAISO control area are around 4,000 MW from both the Northwest and Southwest each during the peak hours. The base case results are characteristic of actual operating conditions in a typical summer in the CAISO.

Limits and hourly flows for existing Branch Groups for the summer, medium load, medium hydro base case are shown in Table 19.

Table 19. Base Case: Branch Group Flows for Summer, Medium Hydro, Medium Load, and No Supply Withdrawn

Branch Group	Min Limit	Max Limit	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
ADLANTOSP_MSL	-502	1036	629	629	630	726	630	630	729	670	729	736	728	720	718	735	728	724	726	736	811	711	709	787	681	668
ADLNTOVICTVL-SP_MSL	-1061	2561	792	791	791	889	793	795	892	838	906	898	983	981	975	1082	1102	1072	1193	1093	1183	1082	963	967	908	932
BLYTHE_BG	-153	216	10	9	9	9	8	11	25	25	115	119	123	125	128	130	132	134	134	133	130	128	127	124	11	11
CAPTAINJACK_BG	-118	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPTAINJACK_MSL	-1446	1417	313	-40	-103	-134	-19	124	-596	-540	-175	-275	-710	-940	-975	-683	-762	-785	-437	-518	-591	-481	-568	-549	213	465
CASCADE_BG	-45	78	78	78	78	78	78	78	0	0	0	0	0	0	0	78	78	78	78	78	78	78	78	78	78	78
CFE_BG	-408	800	0	0	0	55	85	120	162	52	106	100	101	101	97	93	91	88	88	87	88	93	97	101	89	89
CTNWDRDMT_BG	-370	363	-25	-34	-22	-29	-17	5	-76	-92	-96	-102	-124	-148	-166	-149	-166	-171	-152	-159	-156	-168	-180	-146	-100	-48
CTNWDWAPA_BG	-1594	1562	216	155	167	148	179	231	133	134	161	162	83	29	-4	3	-33	-38	-35	-27	14	8	-36	4	137	201
ELDORADO_BG	-1400	1372	850	844	840	868	868	868	709	796	768	777	792	811	826	891	893	892	892	891	828	827	812	803	888	852
FCORNER5SPTO_BG	-99999	99999	930	920	915	960	960	960	712	851	800	820	835	860	887	991	992	992	992	992	892	892	870	855	980	950
FOURCORNER3_5XFMRBG	-99999	99999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONDIPPDC_BG	-51	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IID-SCE_BG	-100	588	491	502	522	542	542	542	588	568	548	493	493	493	588	571	527	523	503	513	553	583	493	493	492	492
IID-SDGE_BG	-225	221	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IPP-IPPGEN_BG	-9999	9999	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480	-480
IPPDCADLN_BG	-471	647	532	532	532	627	532	532	627	532	557	557	557	554	554	556	543	546	554	563	638	537	535	613	535	535
LAUGHLIN_BG	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLNLTESLA_BG	-164	161	31	33	37	40	40	39	43	43	26	31	34	29	30	33	25	29	31	30	30	38	38	36	26	20
MCCLMKTPC_MSL	-686	686	244	247	244	240	225	232	270	248	372	320	398	433	398	371	387	379	385	360	405	378	361	366	322	126
MCCULLGH_MSL	-2598	2546	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
MEADMKTPC_MSL	-369	369	126	126	126	126	126	126	126	136	145	145	145	145	139	152	160	152	145	145	145	145	145	145	183	145
MEADTMEAD_MSL	-182	182	0	0	0	0	0	0	0	10	19	19	19	19	13	26	34	26	19	19	19	19	19	19	57	19
MEAD_MSL	-1460	1431	751	750	721	695	697	721	566	467	638	412	687	794	677	593	643	639	635	575	617	578	554	548	943	251
MERCHANT_BG	-645	632	280	280	280	280	280	280	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	440	280	280
MKTPCADLN_MSL	-423	423	141	141	141	141	141	141	141	176	218	218	218	218	212	225	233	225	218	218	218	218	218	218	198	160
MONAIPPDC_BG	-516	458	52	52	52	147	52	52	147	52	77	77	77	74	74	76	63	66	74	83	158	57	55	133	55	55
N.GILABK4_BG	-366	359	52	52	52	52	52	54	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	52	52
NOB_BG	-1465	2091	0	0	0	0	0	0	1197	1302	1230	1673	1784	1919	2091	2091	2091	2056	2069	2075	2029	1847	1643	1580	584	294
OAKDLSBNS_BG	-425	417	6	-36	-91	-74	-63	-70	-93	-35	7	21	-8	-13	37	96	130	121	145	129	110	151	157	59	100	97
PACI_UPPER_BG	-2450	3200	1161	1085	746	1200	1046	596	1545	1758	1739	1584	1676	1773	1751	1605	1882	1876	1883	1930	1803	2149	2366	2084	2088	1739
PALOVRDE_BG	-3297	3231	2037	1972	1907	1936	1932	1929	1957	1928	2049	2120	2227	2167	2098	2121	2067	1827	1745	1734	1995	1918	2015	2008	1962	1993
PARKER_BG	-60	216	15	15	15	15	15	15	30	30	30	80	66	111	111	111	111	111	111	111	111	111	111	111	15	15
PATH15_BG	-99999	5400	836	1166	1736	1506	1381	1470	1667	1172	791	528	1025	977	262	-449	-1116	-1646	-1920	-1846	-1311	-1082	-1020	-17	-5	-110
PATH26_BG	-4000	99999	-2729	-2415	-1864	-2081	-2204	-2089	-1883	-2309	-2672	-2927	-2457	-2225	-2185	-2191	-2287	-2611	-2869	-2797	-2531	-2971	-3219	-3186	-3242	-3349
RNCHLAKE _BG	-1271	1246	469	423	394	390	411	428	390	448	452	432	395	352	280	303	296	333	322	325	348	357	439	390	458	483
SILVERPK_BG	-17	17	17	17	17	14	12	12	15	17	16	17	11	12	11	12	11	12	11	12	11	12	11	17	16	17
SUMMIT_BG	-100	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	0	0	0	0	0	0	0	0
SUTTEROBNION_BG	-1366	1339	-525	-525	-525	-525	-525	-525	-450	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525
SYLMAR-AC_MSL	-1200	1176	88	88	88	88	88	88	88	88	88	88	88	88	184	186	180	188	168	168	158	158	88	88	88	88
TRACYPGAE_BG	-4388	4265	292	48	-44	-71	17	103	-400	-281	-11	-71	-355	-485	-513	-294	-281	-256	-20	-85	-162	-131	-151	-233	274	442
TRACYPSDO_BG	-99999	99999	278	265	282	284	289	299	283	294	295	292	263	232	194	183	138	155	164	163	182	209	203	230	289	268
TSLASTDFD_BG	-425	417	95	107	135	126	117	119	132	101	93	79	84	87	59	37	12	1	-4	4	18	18	13	69	62	55
VICTVL_MSL	-560	1495	119	118	118	121	120	122	124	130	131	123	208	209	209	301	326	301	421	312	327	327	210	136	175	237
WSTWGMEAD_MSL	-126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126

5.2.2 FI Results

The FI summary results for summer low hydro high load and all 26 withdrawn supplier combinations are presented in Table 20.

Table 20. FI Results for Summer - Low Hydro and High Load Scenarios

Candidate Path	Minimum FI	Hours w/ FI < 0	Percent of Hours w/ FI < 0
Contra Costa 230kV Import			
ElCentro 230/161 kV Bank			
HUMBOLDT_BG			
Humboldt Bank			
Imperial Valley Bank			
MIGUEL_MAXIMP_LNXFMRBG			
Miguel 500/230 kV Banks			
Monta Vista - Jefferson			
Moss Landing to Metcalf	-0.60	16	2.6%
PITSBRG_XFMRBG	-0.14	107	17.1%
Pittsburg to San Mateo_E. Shore			
Ravenswood Cutplane			
Ravenswood to San Mateo			
SDGEIMP_LNXFMRBG	0.00	2	0.3%
SDGE_CFEIMP_BG			
SOUTHLUGO_BG			
Serrano Bank			
Tesla Banks 4 & 6			
Tesla Banks 6 & 4			
Tesla to Delta Switchyard			
Tesla to Pittsburg			
Vaca Bank & Tesla Bank 6			
Victorville-Lugo (HA-NG)			
Vincent Bank			

Note here that in the summer low hydro high load results, three candidate path failed the test, two of which already failed in Spring scenarios. One additional failed candidate paths in the SP26 area is SDGEIMP_LNXFMRBG (SDGE Imports).

PITSBRG_XFMRBG is still the most frequently violated candidate paths for the summer high load low hydro scenario as in spring counterparts.

The FI summary results for all load and hydro scenarios and supplier withdrawn combinations in summer are presented in Table 21.

Table 21. FI Results for Summer - All Hydro and Load Scenarios

Candidate Path	Minimum FI	Hours w/ FI < 0	Percent of Hours w/ FI < 0
Contra Costa 230kV Import			
ElCentro 230/161 kV Bank			
HUMBOLDT_BG			
Humboldt Bank			
Imperial Valley Bank			
MIGUEL_MAXIMP_LNXFMRBG			
Miguel 500/230 kV Banks			
Monta Vista - Jefferson			
Moss Landing to Metcalf	-0.61	26	0.5%
PITSBRG_XFMRBG	-0.18	363	6.5%
Pittsburg to San Mateo_E. Shore			
Ravenswood Cutplane			
Ravenswood to San Mateo			
SDGEIMP_LNXFMRBG	0.00	2	0.0%
SDGE_CFEIMP_BG			
SOUTHLUGO_BG			
Serrano Bank			
Tesla Banks 4 & 6			
Tesla Banks 6 & 4			
Tesla to Delta Switchyard			
Tesla to Pittsburg			
Vaca Bank & Tesla Bank 6			
Victorville-Lugo (HA-NG)			
Vincent Bank			

The all hydro and load scenario results for the summer season are similar to low hydro high load summer scenario results, with the same three candidate paths failed the test.

For the summer scenarios, load is curtailed in 6 out of 5,616 tested hours, and in 3 out of 234 scenarios – all occurred under low hydro high load and three suppliers withdrawn cases.

5.3 Fall Season Results

5.3.1 Base Case Results

The base case results for fall are presented in Table 22 below for medium load, medium hydro, and no supplier capacity withdrawn. General simulation characteristics are presented including load, average LMPs, total generation internal to the CAISO, net import values, and internal path flows (Path 15 and Path 26) for each of the 24 hours of the fall medium load medium hydro base case.

Table 22. Base Case: Model Output for Fall, Medium Hydro, Medium Load, and No Supply Withdrawn

	Load (MWh)		Price ($/MWh)		Generation (MWh)		Net Import		Internal Path Flow (MWh)	
Hour	NP26	SP26	NP26	SP26	NP26	SP26	NW	SW	P15 (S->N)	P26 (S->N)
1	9,671	11,763	$52.10	$46.84	12,205	7,234	612	3,919	1,252	-2,167
2	9,683	11,330	$52.34	$46.98	12,421	7,253	575	3,919	1,619	-1,941
3	9,536	11,063	$51.50	$45.63	12,042	6,832	811	4,064	1,253	-2,039
4	9,555	11,097	$52.55	$46.68	12,376	7,080	569	3,690	1,424	-2,022
5	9,915	11,610	$52.69	$46.87	12,903	7,240	584	3,886	1,525	-2,130
6	10,493	12,723	$56.38	$49.79	13,584	7,519	495	4,143	1,604	-2,304
7	12,006	14,198	$62.54	$51.85	15,102	8,821	516	4,113	1,029	-2,817
8	12,325	14,645	$63.37	$52.83	15,307	9,035	423	3,985	917	-2,906
9	12,538	15,368	$62.78	$52.22	15,396	9,141	420	3,996	582	-3,212
10	12,798	16,086	$62.59	$52.31	15,404	9,353	413	4,177	597	-3,223
11	13,037	16,593	$62.14	$52.06	15,787	9,227	579	4,229	212	-3,635
12	12,989	16,961	$62.53	$52.59	15,861	9,388	708	4,368	138	-3,728
13	13,094	17,302	$62.77	$53.09	15,997	9,510	1,248	4,399	-156	-4,000
14	13,287	17,524	$63.71	$55.06	16,692	9,927	672	4,517	-38	-3,877
15	13,275	17,521	$63.62	$54.66	16,602	9,909	658	4,517	7	-3,845
16	13,204	17,287	$63.04	$53.79	16,278	9,797	709	4,406	85	-3,783
17	13,122	16,785	$62.41	$51.88	16,083	9,219	776	4,141	-86	-3,944
18	13,017	16,444	$60.85	$47.55	15,933	7,660	1,406	4,480	18	-3,841
19	13,972	17,656	$63.65	$51.20	16,784	8,346	1,776	4,587	-125	-4,000
20	13,774	17,289	$63.69	$50.08	16,693	8,072	1,581	4,581	-116	-4,000
21	13,123	16,486	$62.02	$48.82	15,983	8,049	1,086	4,459	342	-3,545
22	12,234	15,148	$60.64	$49.09	15,047	7,998	516	4,232	674	-3,238
23	11,165	13,639	$58.64	$47.86	13,449	7,642	391	4,345	1,333	-2,586
24	10,286	12,351	$53.93	$47.50	12,620	7,159	391	4,345	1,380	-2,237

The load-weighted zonal LMPs for both NP26 and SP26 are below $65/MWh throughout the day, which reflects the typical mild demand condition in fall. The peak demand hour changed from late afternoon in summer to earlier evening in fall. The power flows on the internal paths are from north-to-south (from ZP26 into SP15) for Path 26. Except several peak hours, most of the time the power flows were from south-to-north (ZP26 to NP15) for Path 15. Path 26 is binding from north-to-south in hours 13, 19 and 20 with a rating of 4,000 MW. The total imports into the CAISO control area are over 4,000 MW from the Southwest during the peak hours while imports from the Northwest are reduced considerably due to less hydro power production during the fall season. The base case results are characteristic of actual operating conditions in a typical fall in the CAISO.

Limits and hourly flows for existing Branch Groups for the fall, medium load, medium hydro base case are shown in Table 23.

Table 23. Base Case: Branch Group Flows for Fall, Medium Hydro, Medium Load, and No Supply Withdrawn

Branch Group	Min Limit	Max Limit	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
ADLANTOSP_MSL	-502	1036	672	672	696	651	654	731	705	736	700	699	704	737	737	736	736	722	728	725	740	738	731	719	712	676
ADLNTOVICTVL-SP_MSL	-1061	2561	940	940	965	920	924	1002	981	1012	975	1000	979	1012	1012	1012	1012	1022	1026	1236	1288	1286	1205	994	992	958
BLYTHE_BG	-153	216	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	7
CAPTAINJACK_BG	-79	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPTAINJACK_MSL	-1446	1417	-97	-257	-194	-238	-321	-312	-21	25	160	214	221	97	-89	-92	-66	5	153	-364	-564	-488	-361	-66	-109	-59
CASCADE_BG	-45	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CFE_BG	-408	800	195	220	220	220	220	205	175	155	105	85	75	75	75	75	75	75	55	55	85	55	55	145	105	105
CTNWDRDMT_BG	-370	363	-91	-94	-102	-95	-99	-96	-56	-55	-51	-47	-51	-60	-89	-63	-62	-59	-54	-120	-144	-132	-106	-63	-45	-55
CTNWDWAPA_BG	-1594	1562	167	154	151	156	143	153	335	331	345	331	323	300	244	302	304	317	323	142	103	131	165	272	334	318
ELDORADO_BG	-1400	1372	834	834	916	708	803	899	880	832	863	943	926	974	974	1038	1038	974	831	841	857	873	885	958	1056	1089
FCORNER5SPTO_BG	-99999	99999	910	910	1040	710	860	1010	985	910	960	1085	1060	1135	1135	1235	1235	1135	910	910	935	960	980	1110	1260	1310
FOURCORNER3_5XFMRBG	-99999	99999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONDIPPDC_BG	-51	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IID-SCE_BG	-50	588	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488	488
IID-SDGE_BG	-225	221	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IPP-IPPGEN_BG	-9999	9999	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477	-477
IPPDCADLN_BG	-471	647	585	585	610	565	569	647	616	647	610	610	614	647	647	647	647	632	631	631	647	647	647	629	627	593
LAUGHLIN_BG	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLNLTESLA_BG	-256	251	31	33	32	32	33	34	41	40	33	33	33	35	37	39	40	38	34	30	34	33	31	30	38	35
MCCLMKTPC_MSL	-686	686	182	183	152	237	209	190	154	172	146	123	117	108	106	88	88	107	153	289	291	284	273	112	111	104
MCCULLGH_MSL	-2598	2546	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEADMKTPC_MSL	-369	369	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	131	141	140	138	132	126	126	126
MEADTMEAD_MSL	-182	182	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	15	14	12	6	0	0	0
MEAD_MSL	-1460	1431	505	504	474	574	575	575	441	441	401	400	375	375	375	374	374	374	376	794	798	797	801	377	476	500
MERCHANT_BG	-645	632	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485
MKTPCADLN_MSL	-423	423	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	131	141	140	138	132	126	126	126
MONAIPPDC_BG	-544	478	108	108	133	88	92	170	139	170	133	133	137	170	170	170	170	155	154	154	170	170	170	152	150	116
N.GILABK4_BG	-366	359	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
NOB_BG	-1465	2091	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0
OAKDLSBNS_BG	-425	417	-16	-47	-12	-27	-31	-44	24	35	60	72	91	96	125	94	93	102	79	46	72	68	21	34	4	-9
PACI_UPPER_BG	-2450	3200	582	545	781	539	554	465	486	393	390	383	549	678	1218	642	628	679	746	1301	1746	1551	1056	486	361	361
PALOVRDE_BG	-3297	3231	1874	1849	1839	1839	1882	1925	1972	1908	1956	2007	2115	2146	2177	2195	2195	2174	2150	2279	2278	2280	2219	1983	1988	1972
PARKER_BG	-60	216	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	14	14
PATH15_BG	-99999	5400	1252	1619	1253	1424	1525	1604	1029	917	582	597	212	138	-156	-38	7	85	-86	18	-125	-116	342	674	1333	1380
PATH26_BG	-4000	99999	-2167	-1941	-2039	-2022	-2130	-2304	-2817	-2906	-3212	-3223	-3635	-3728	-4000	-3877	-3845	-3783	-3944	-3841	-4000	-4000	-3545	-3238	-2586	-2237
RNCHLAKE _BG	-1700	1964	253	253	240	232	232	226	308	283	317	342	348	348	357	357	358	359	316	163	194	200	162	259	293	290
SILVERPK_BG	-17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
SUMMIT_BG	-100	69	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
SUTTEROBNION_BG	-1492	1462	-250	-250	-250	-250	-250	-250	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-525	-250	-379	-402	-319	-525	-250	-250
SYLMAR-AC_MSL	-1200	1176	10	110	110	110	110	110	65	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11
TRACYPGAE_BG	-4388	4265	5	-121	-46	-85	-142	-145	169	205	325	362	372	308	215	168	183	259	387	-19	-111	-57	-21	183	133	103
TRACYPSDO_BG	-99999	99999	309	315	320	318	308	310	315	307	314	315	310	307	295	302	306	304	309	271	253	262	279	315	341	341
TSLASTDFD_BG	-425	417	70	87	64	69	72	76	65	51	41	39	26	22	10	22	23	19	32	42	33	40	66	73	83	91
VICTVL_MSL	-560	1495	229	229	229	229	229	229	239	239	239	264	239	239	239	239	239	264	264	464	501	501	426	239	239	239
WSTWGMEAD_MSL	-126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126

5.3.2 FI Results

All candidate paths passed the FI test for all fall scenarios.

5.4 Winter Season Results

5.4.1 Base Case Results

The base case results for winter are presented in Table 24 below for medium load, medium hydro, and no supplier capacity withdrawn. General simulation characteristics are presented including load, average LMPs, total generation internal to the CAISO, net import values, and internal path flows (Path 15 and Path 26) for each of the 24 hours of the winter medium load medium hydro base case.

Table 24. Base Case: Model Output for Winter, Medium Hydro, Medium Load, and No Supply Withdrawn

	Load (MWh)		Price ($/MWh)		Generation (MWh)		Net Import		Internal Path Flow (MWh)	
Hour	NP26	SP26	NP26	SP26	NP26	SP26	NW	SW	P15 (S->N)	P26 (S->N)
1	9,688	11,849	$51.54	$46.77	10,215	6,470	1,048	4,299	1,546	-1,387
2	9,738	11,455	$54.62	$48.60	10,687	6,721	862	3,973	1,910	-1,485
3	9,616	11,307	$54.72	$48.60	10,624	7,311	762	3,816	2,268	-1,112
4	9,631	11,375	$54.62	$48.60	10,944	7,256	630	3,768	2,110	-1,274
5	9,733	11,994	$54.87	$49.19	10,886	7,474	517	3,785	2,020	-1,371
6	10,454	13,353	$55.60	$49.84	11,909	7,344	510	4,052	1,880	-1,810
7	12,014	14,720	$64.05	$52.34	13,509	8,262	1,108	3,630	1,884	-2,096
8	12,284	15,133	$64.68	$51.75	13,646	8,083	1,481	3,508	1,735	-2,243
9	12,335	15,482	$63.75	$50.56	13,542	7,703	1,509	3,624	1,499	-2,467
10	12,506	15,697	$64.68	$51.74	13,678	8,141	1,701	3,595	1,643	-2,349
11	12,526	15,758	$64.35	$50.52	13,655	8,087	1,833	3,643	1,569	-2,416
12	12,452	15,830	$64.00	$51.62	13,631	8,185	1,768	3,602	1,580	-2,403
13	12,375	15,815	$63.68	$51.62	13,564	8,185	1,729	3,630	1,589	-2,390
14	12,347	15,795	$63.07	$51.47	13,374	8,192	2,017	3,542	1,606	-2,373
15	12,186	15,591	$62.73	$50.44	13,280	7,901	1,904	3,667	1,596	-2,384
16	12,210	15,378	$62.93	$50.53	13,267	7,919	1,690	3,620	1,812	-2,172
17	12,618	15,434	$64.04	$50.88	13,533	7,747	2,174	3,592	1,782	-2,200
18	13,809	17,253	$68.03	$56.23	15,451	8,880	2,005	3,687	1,274	-2,690
19	13,724	17,136	$67.67	$52.68	15,083	8,356	2,998	3,625	1,171	-2,794
20	13,299	16,739	$65.91	$51.98	14,580	8,259	2,717	3,596	923	-3,034
21	12,700	15,984	$64.67	$52.07	14,066	8,195	2,012	3,574	1,417	-2,561
22	11,755	14,708	$61.00	$50.63	11,970	7,968	2,117	3,528	1,422	-1,804
23	10,713	13,334	$55.49	$48.61	11,536	6,857	1,700	3,934	767	-2,415
24	10,099	12,435	$54.02	$46.62	11,001	6,658	1,238	3,869	1,104	-2,058

Similar to the fall base case, the zonal LMPs are relatively low due to relatively mild demand. The imports from the Northwest and Southwest are lower reflecting the end of the hydro recharge period preceding the high hydro spring season.

Limits and hourly flows for existing Branch Groups for the winter, medium load, medium hydro base case are shown in Table 25.

Table 25. Base Case: Branch Group Flows for Winter, Medium Hydro, Medium Load, and No Supply Withdrawn

Branch Group	Min Limit	Max Limit	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
ADLANTOSP_MSL	-502	1036	546	554	458	459	459	480	406	408	406	416	467	415	415	419	455	455	457	458	418	418	465	470	497	460
ADLNTOVICTVL-SP_MSL	-1061	2561	886	881	736	736	736	771	571	574	584	586	636	586	586	584	622	625	624	623	584	584	632	637	781	746
BLYTHE_BG	-153	216	11	10	10	10	10	10	20	21	22	23	24	25	26	26	26	25	25	25	25	24	23	21	12	10
CAPTAINJACK_BG	-118	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPTAINJACK_MSL	-1446	1417	544	505	351	337	398	276	42	-12	51	38	22	34	28	29	87	99	55	-18	-424	-310	-167	137	307	457
CASCADE_BG	-45	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CFE_BG	-408	800	290	325	345	355	345	345	384	374	319	284	264	254	264	259	259	264	269	249	209	189	189	234	200	225
CTNWDRDMT_BG	-370	363	-68	-62	-64	-57	-39	-52	-62	-65	-69	-72	-80	-76	-70	-77	-71	-60	-71	-58	-122	-132	-94	-91	-102	-79
CTNWDWAPA_BG	-1594	1562	133	148	129	126	197	176	197	209	207	181	163	176	197	187	198	216	196	213	93	67	137	136	99	142
ELDORADO_BG	-1400	1372	1053	902	902	870	870	904	775	667	675	744	747	750	760	720	748	729	726	746	750	737	717	715	913	907
FCORNER5SPTO_BG	-99999	99999	1244	1019	1019	969	969	1009	810	635	635	754	760	764	779	720	762	730	730	760	765	745	713	710	1029	1019
FOURCORNER3_5XFMRBG	-99999	99999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONDIPPDC_BG	-51	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IID-SCE_BG	-50	588	488	488	488	461	461	405	405	389	390	390	390	386	386	388	388	388	388	388	388	388	388	388	388	388
IID-SDGE_BG	-225	221	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IPP-IPPGEN_BG	-9999	9999	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238	-238
IPPDCADLN_BG	-471	647	445	440	345	345	345	380	290	290	290	290	340	290	290	290	290	290	290	290	290	290	290	290	380	345
LAUGHLIN_BG	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLNLTESLA_BG	-256	251	36	44	45	44	37	39	46	46	47	47	48	48	49	49	47	47	49	55	53	51	50	52	39	38
MCCLMKTPC_MSL	-686	686	233	189	173	182	183	285	251	329	426	314	311	315	311	302	362	381	355	355	303	302	386	416	228	235
MCCULLGH_MSL	-2598	2546	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEADMKTPC_MSL	-369	369	126	126	126	126	126	126	151	156	166	166	166	166	166	166	166	166	166	166	166	166	166	151	136	136
MEADTMEAD_MSL	-182	182	0	0	0	0	0	0	25	30	40	40	40	40	40	40	40	40	40	40	40	40	40	25	10	10
MEAD_MSL	-1460	1431	846	520	520	520	521	926	726	883	1236	894	861	906	903	824	848	884	782	804	856	856	847	853	727	763
MERCHANT_BG	-645	632	280	280	280	280	280	280	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	280	280
MKTPCADLN_MSL	-423	423	151	151	151	151	151	151	166	171	181	181	181	181	181	181	219	220	219	220	181	181	229	234	161	161
MONAIPPDC_BG	-545	478	207	202	107	107	107	142	52	52	52	52	102	52	52	52	52	52	52	52	52	52	52	52	142	107
N.GILABK4_BG	-366	359	0	0	0	0	0	0	0	0	32	56	56	56	56	56	56	56	56	57	57	57	56	56	53	53
NOB_BG	-1465	2091	150	150	150	150	150	100	371	590	440	671	671	671	671	821	821	821	1096	1096	1174	714	683	635	125	125
OAKDLSBNS_BG	-425	417	-94	-134	-167	-151	-138	-127	-75	-84	-65	-75	-69	-70	-72	-77	-80	-83	-73	-48	-28	-16	-67	-71	-31	-63
PACI_UPPER_BG	-2450	3200	829	643	562	430	317	360	687	823	1000	961	1093	1029	990	1127	1015	800	1009	840	1755	1934	1260	1413	1506	1044
PALOVRDE_BG	-2792	2736	1879	1748	1716	1708	1735	1927	1865	1925	2086	1971	1983	1998	2001	1979	2024	2001	1969	2055	2067	2078	2040	1947	1924	1879
PARKER_BG	-60	216	12	12	12	12	12	12	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	12	12
PATH15_BG	-99999	5400	1546	1910	2268	2110	2020	1880	1884	1735	1499	1643	1569	1580	1589	1606	1596	1812	1782	1274	1171	923	1417	1422	767	1104
PATH26_BG	-3700	99999	-1387	-1485	-1112	-1274	-1371	-1810	-2096	-2243	-2467	-2349	-2416	-2403	-2390	-2373	-2384	-2172	-2200	-2690	-2794	-3034	-2561	-1804	-2415	-2058
RNCHLAKE _BG	-1700	1964	170	178	177	176	186	185	321	238	220	219	218	239	266	235	224	238	244	359	307	225	238	220	184	176
SILVERPK_BG	-17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
SUMMIT_BG	-100	69	69	69	50	50	50	50	50	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
SUTTEROBNION_BG	-1492	1462	-250	-250	-250	-250	-250	-250	-525	-316	-250	-257	-250	-316	-360	-280	-250	-250	-250	-525	-478	-277	-331	-250	-250	-250
SYLMAR-AC_MSL	-1200	1176	111	111	111	111	111	111	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	111	111
TRACYPGAE_BG	-4388	4265	231	160	38	52	143	101	53	31	81	52	40	58	67	47	77	80	59	98	-136	-98	-39	53	183	236
TRACYPSDO_BG	-99999	99999	373	387	395	364	370	349	351	335	331	331	328	340	350	356	352	350	341	334	311	303	332	358	342	360
TSLASTDFD_BG	-425	417	126	149	166	156	149	141	131	128	118	125	123	122	125	127	128	130	129	118	102	92	116	124	91	106
VICTVL_MSL	-560	1495	290	290	240	240	240	240	115	113	113	115	115	115	115	113	113	115	115	113	113	113	113	113	240	240
WSTWGMEAD_MSL	-126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126

5.4.2 FI Results

All candidate paths passed the FI test for all winter scenarios.

5.5 FI Results Summary

Summing up the results for all four seasons, the final candidate path competitiveness test results are shown. Note that if a candidate path fails the competitive test in one season, that path will be designated as uncompetitive for the entire year.

Table 26. FI Results Summary

Candidate Path	Minimum FI	Hours w/ FI < 0	Test w/ 0% FI < 0
Contra Costa 230kV Import	-0.01	8	Fail
ElCentro 230/161 kV Bank			**Pass**
HUMBOLDT_BG			**Pass**
Humboldt Bank	-0.03	21	Fail
Imperial Valley Bank			**Pass**
MIGUEL_MAXIMP_LNXFMRBG			**Pass**
Miguel 500/230 kV Banks			**Pass**
Monta Vista - Jefferson	-0.02	3	Fail
Moss Landing to Metcalf	-0.79	34	Fail
PITSBRG_XFMRBG	-0.27	808	Fail
Pittsburg to San Mateo_E. Shore			**Pass**
Ravenswood Cutplane			**Pass**
Ravenswood to San Mateo			**Pass**
SDGEIMP_LNXFMRBG	0.00	2	Fail
SDGE_CFEIMP_BG			**Pass**
SOUTHLUGO_BG			**Pass**
Serrano Bank			**Pass**
Tesla Banks 4 & 6			**Pass**
Tesla Banks 6 & 4			**Pass**
Tesla to Delta Switchyard			**Pass**
Tesla to Pittsburg			**Pass**
Vaca Bank & Tesla Bank 6	-0.03	16	Fail
Victorville-Lugo (HA-NG)			**Pass**
Vincent Bank			**Pass**

Overall, 17 out of 24 aggregated candidate paths passed the four seasonal FI tests and would be designated as competitive paths. Eight of these seventeen are in the SP26 area. As noted, all of the candidate paths that are individual transmission lines passed the four seasonal FI tests.

The seasonal test results are summarized in Table 27. Candidate paths only failed in spring or summer scenarios when demands are high.

Table 27. FI Results Summary by Season

Candidate Path	Spring	Summer	Fall	Winter	All
Contra Costa 230kV Import	Fail				Fail
ElCentro 230/161 kV Bank					**Pass**
HUMBOLDT_BG					**Pass**
Humboldt Bank	Fail				Fail
Imperial Valley Bank					**Pass**
MIGUEL_MAXIMP_LNXFMRBG					**Pass**
Miguel 500/230 kV Banks					**Pass**
Monta Vista - Jefferson	Fail				Fail
Moss Landing to Metcalf	Fail	Fail			Fail
PITSBRG_XFMRBG	Fail	Fail			Fail
Pittsburg to San Mateo_E. Shore					**Pass**
Ravenswood Cutplane					**Pass**
Ravenswood to San Mateo					**Pass**
SDGEIMP_LNXFMRBG		Fail			Fail
SDGE_CFEIMP_BG					**Pass**
SOUTHLUGO_BG					**Pass**
Serrano Bank					**Pass**
Tesla Banks 4 & 6					**Pass**
Tesla Banks 6 & 4					**Pass**
Tesla to Delta Switchyard					**Pass**
Tesla to Pittsburg					**Pass**
Vaca Bank & Tesla Bank 6	Fail				Fail
Victorville-Lugo (HA-NG)					**Pass**
Vincent Bank					**Pass**

The aggregated candidate paths that passed the FI tests and would become competitive paths in MPM-RRD runs in IFM and RTM under MRTU[23] are shown in Table 28. The single candidate paths that passed the tests are shown in Table 29.

[23] Please refer to Market Operation Business Practice Manual for additional market operation information. The documents can be found at http://www.caiso.com/17ba/17baa8bc1ce20.html.

Table 28. Competitive Path List – Aggregated Constraints

Competitive Path	Transmission Segment
ElCentro 230/161 kV Bank	22356_IVALLY 1_230_21025_ELCNTO 1_230_1_CKT
ElCentro 230/161 kV Bank	22360_IVALLY 2_500_22536_NGILA 1_500_1_CKT
HUMBOLDT_BG	31000_HUMBSB 1_115_31452_TRINTY 1_115_1_CKT
HUMBOLDT_BG	31015_BRDGVL 1_115_31010_LOWGAP 1_115_1_CKT
HUMBOLDT_BG	31093_GRSCRK 2_60_31092_MPLCRK 1_60_1_CKT
HUMBOLDT_BG	31116_GARBVL 1_60_31118_KEKAWK 1_60_1_CKT
Imperial Valley Bank	22356_IVALLY 1_230_22360_IVALLY 2_500_1_CKT
Imperial Valley Bank	22356_IVALLY 1_230_22360_IVALLY 2_500_2_CKT
Miguel 500/230 kV Banks	22356_IVALLY 1_230_22994_TERMEX 1_230_1_CKT
Miguel 500/230 kV Banks	22356_IVALLY 1_230_22994_TERMEX 1_230_2_CKT
Miguel 500/230 kV Banks	22356_IVALLY 1_230_22998_LAROA2 1_230_1_CKT
Miguel 500/230 kV Banks	22356_IVALLY 1_230_22998_LAROA2 1_230_2_CKT
Miguel 500/230 kV Banks	22464_MIGUEL 1_230_22468_MIGUEL 3_500_1_CKT
Miguel 500/230 kV Banks	22468_MIGUEL 3_500_22472_MIGUEL 4_1_1_CKT
MIGUEL_MAXIMP_LNXFMRBG	22464_MIGUEL 1_230_20149_TJUANA 1_230_1_CKT
MIGUEL_MAXIMP_LNXFMRBG	22464_MIGUEL 1_230_22468_MIGUEL 3_500_1_CKT
MIGUEL_MAXIMP_LNXFMRBG	22468_MIGUEL 3_500_22472_MIGUEL 4_1_1_CKT
Pittsburg to San Mateo_E. Shore	30527_PITTSP 5_230_99100_PITTSP 7_230_1_CKT
Pittsburg to San Mateo_E. Shore	30527_PITTSP 5_230_99102_PITTSP 6_230_1_CKT
Ravenswood Cutplane	30630_NEWARK 3_230_30703_RAVENS 2_230_1_CKT
Ravenswood Cutplane	30703_RAVENS 2_230_30624_TESLA 3_230_1_CKT
Ravenswood Cutplane	35349_AMES 2_115_35122_NEWARK 1_115_1_CKT
Ravenswood to San Mateo	30703_RAVENS 2_230_30700_SANMAT 8_230_1_CKT
Ravenswood to San Mateo	30703_RAVENS 2_230_30700_SANMAT 8_230_2_CKT
Ravenswood to San Mateo	33315_RAVENS 1_115_33310_SANMAT 1_115_1_CKT
SDGE_CFEIMP_BG	22356_IVALLY 1_230_20118_ROA 1_230_1_CKT
SDGE_CFEIMP_BG	24131_SONGS 1_230_22716_SANLUS 2_230_1_CKT
SDGE_CFEIMP_BG	24131_SONGS 1_230_22716_SANLUS 2_230_2_CKT
SDGE_CFEIMP_BG	24131_SONGS 1_230_22716_SANLUS 2_230_3_CKT
SDGE_CFEIMP_BG	24131_SONGS 1_230_22844_TALEGA 2_230_1_CKT
SDGE_CFEIMP_BG	24131_SONGS 1_230_22844_TALEGA 2_230_2_CKT
SDGE_CFEIMP_BG	94_IVALLY 3_500_22468_MIGUEL 3_500_1_CKT
Serrano Bank	24138_SERRAN 1_500_24137_SERRAN 6_230_1_CKT
Serrano Bank	24138_SERRAN 1_500_24184_SERRAN 2_1_1_CKT
Serrano Bank	24138_SERRAN 1_500_24186_SERRAN 3_1_1_CKT
SOUTHLUGO_BG	24086_LUGO 5_500_24092_MIRLOM 7_500_1_CKT
SOUTHLUGO_BG	24086_LUGO 5_500_24092_MIRLOM 7_500_2_CKT
SOUTHLUGO_BG	24086_LUGO 5_500_24092_MIRLOM 7_500_3_CKT
Tesla Banks 4 & 6	30625_TESLA 5_230_30040_TESLA 6_500_1_CKT
Tesla Banks 4 & 6	30640_TESLA 4_230_30040_TESLA 6_500_1_CKT
Tesla Banks 6 & 4	30625_TESLA 5_230_30040_TESLA 6_500_1_CKT
Tesla Banks 6 & 4	30640_TESLA 4_230_30040_TESLA 6_500_1_CKT
Tesla to Delta Switchyard	30580_ALTMID 1_230_38610_BANKPP 6_230_1_CKT
Tesla to Pittsburg	30595_FLOWD2 2_230_30640_TESLA 4_230_1_CKT
Tesla to Pittsburg	30600_JVENTR 1_230_30640_TESLA 4_230_1_CKT
Victorville-Lugo (HA-NG)	24086_LUGO 5_500_26105_VICTVL 1_500_1_CKT
Victorville-Lugo (HA-NG)	95_NGILA 2_500_15090_HASAMP 1_500_1_CKT
Vincent Bank	24155_VINCNT 7_230_24156_VINCNT 8_500_1_CKT
Vincent Bank	24188_VINCNT 1_1_24156_VINCNT 8_500_1_CKT
Vincent Bank	24248_VINCNT 3_1_24156_VINCNT 8_500_1_CKT

Table 29. Competitive Path List – Single Transmission Segments

Competitive Path	Competitive Path
30685_EMBARC 2_230_99160_MARTIN 3_230_1_CKT	33207_BAYSHR 2_115_33208_MARTIN 1_115_1_CKT
33200_LARKIN 2_115_33203_MISSIX 1_115_1_CKT	33208_MARTIN 1_115_30695_MARTIN 2_230_1_CKT
33200_LARKIN 2_115_33204_POTRPP 1_115_1_CKT	33208_MARTIN 1_115_30695_MARTIN 2_230_2_CKT
33200_LARKIN 2_115_33208_MARTIN 1_115_1_CKT	33208_MARTIN 1_115_33307_MILBRA 1_115_1_CKT
30435_LAKVIL 2_230_30540_SOBRNT 4_230_1_CKT	33208_MARTIN 1_115_33310_SANMAT 1_115_1_CKT
30437_CROKET 3_230_30540_SOBRNT 4_230_1_CKT	33208_MARTIN 1_115_33322_UNTDQF 2_115_1_CKT
30465_BAHIA 2_230_30460_VACADX 3_230_1_CKT	33303_EGRAND 1_115_33208_MARTIN 1_115_1_CKT
30467_PRKWAY 1_230_30460_VACADX 3_230_1_CKT	33303_EGRAND 1_115_33308_SFIAMA 1_115_1_CKT
30472_PEABDY 1_230_30460_VACADX 3_230_1_CKT	33306_SFARPT 1_115_33322_UNTDQF 2_115_1_CKT
30478_LMBEPK 5_230_30460_VACADX 3_230_1_CKT	33307_MILBRA 1_115_33310_SANMAT 1_115_1_CKT
30527_PITTSP 5_230_30555_SANRAM 1_230_1_CKT	33310_SANMAT 1_115_33306_SFARPT 1_115_1_CKT
30560_EASTSH 2_230_30700_SANMAT 8_230_1_CKT	33310_SANMAT 1_115_33308_SFIAMA 1_115_1_CKT
30560_EASTSH 2_230_99100_PITTSP 7_230_1_CKT	33312_BELMNT 1_115_33310_SANMAT 1_115_1_CKT
30569_KELSO 1_230_30570_USWND4 1_230_1_CKT	37514_TRACY5 1_230_30035_TRACY5 3_500_1_CKT
30624_TESLA 3_230_30040_TESLA 6_500_1_CKT	37515_TRACY5 2_230_30035_TRACY5 3_500_1_CKT
30625_TESLA 5_230_37585_TRCYPP 5_230_1_CKT	99106_SANMAT10_230_99106_SANMAT11_230_1_CKT
30625_TESLA 5_230_37585_TRCYPP 5_230_2_CKT	99102_PITTSP 6_230_30567_TESSUB 2_230_1_CKT
30630_NEWARK 3_230_30624_TESLA 3_230_1_CKT	24804_DEVERS 4_230_24132_SBERDO10_230_1_CKT
30685_EMBARC 1_230_99158_MARTIN 7_230_1_CKT	24804_DEVERS 4_230_24132_SBERDO10_230_2_CKT
30700_SANMAT 8_230_30567_TESSUB 2_230_1_CKT	24804_DEVERS 4_230_24901_VISTA 3_230_1_CKT
30701_SANMAT 5_1_30700_SANMAT 8_230_1_CKT	24805_DEVERS 1_115_24804_DEVERS 4_230_1_CKT
30702_SANMAT 6_1_30700_SANMAT 8_230_1_CKT	24805_DEVERS 1_115_24804_DEVERS 4_230_2_CKT
30704_SANMAT 7_1_30700_SANMAT 8_230_1_CKT	24805_DEVERS 1_115_24804_DEVERS 4_230_3_CKT
30715_JEFRSN 1_230_30710_SLAC 2_230_1_CKT	22052_BQUTOS 2_138_22228_ENCINA 4_138_1_CKT
30715_JEFRSN 1_230_30712_SLAC 3_230_1_CKT	22052_BQUTOS 2_138_22648_PQUTOS 3_138_1_CKT
30717_JEFRSN 4_230_99170_MARTIN 5_230_1_CKT	22227_ENCINA 6_230_22261_PALOMR 4_230_1_CKT
30735_METCLF 4_230_30042_METCLF 5_500_1_CKT	22227_ENCINA 6_230_22716_SANLUS 2_230_1_CKT
30735_METCLF 4_230_30042_METCLF 5_500_2_CKT	22232_ENCINA 5_230_22716_SANLUS 2_230_1_CKT
30735_METCLF 4_230_30042_METCLF 5_500_3_CKT	22260_ESCNDO 6_230_22261_PALOMR 4_230_1_CKT
30750_MOSSLD11_230_30045_MOSSLD13_500_1_CKT	22260_ESCNDO 6_230_22261_PALOMR 4_230_2_CKT
31080_HUMBSB 4_60_31092_MPLCRK 1_60_1_CKT	22260_ESCNDO 6_230_22844_TALEGA 2_230_1_CKT
31110_BRDGVL 4_60_31112_FRTLND 1_60_1_CKT	22261_PALOMR 4_230_22832_SXCYN 2_230_1_CKT
33200_LARKIN 1_115_33204_POTRPP 1_115_1_CKT	22464_MIGUEL 1_230_22504_MSSION 1_230_1_CKT
33203_MISSIX 1_115_33204_POTRPP 1_115_1_CKT	22464_MIGUEL 1_230_22504_MSSION 1_230_2_CKT
33205_HUNTER 1_115_33203_MISSIX 1_115_1_CKT	22464_MIGUEL 1_230_22596_OLDTWN 1_230_1_CKT
33205_HUNTER 1_115_33203_MISSIX 1_115_2_CKT	22464_MIGUEL 1_230_22832_SXCYN 2_230_1_CKT
33205_HUNTER 1_115_33204_POTRPP 1_115_1_CKT	22464_MIGUEL 1_230_22832_SXCYN 2_230_2_CKT
33205_HUNTER 1_115_33208_MARTIN 1_115_1_CKT	22504_MSSION 1_230_22596_OLDTWN 1_230_1_CKT
33205_HUNTER 1_115_33208_MARTIN 1_115_2_CKT	22504_MSSION 1_230_22596_OLDTWN 1_230_2_CKT
33206_BAYSHR 1_115_33204_POTRPP 1_115_1_CKT	22504_MSSION 1_230_22716_SANLUS 2_230_1_CKT
33206_BAYSHR 1_115_33208_MARTIN 1_115_1_CKT	22504_MSSION 1_230_22716_SANLUS 2_230_2_CKT
33207_BAYSHR 2_115_33204_POTRPP 1_115_1_CKT	22596_OLDTWN 1_230_22652_PQUTOS 1_230_1_CKT

Table 30 and Table 31 below show the distribution of all the negative FIs on candidate paths upon 9 different hydro and load scenarios. Not surprisingly, most of the line flow violations occur under high load scenarios.

Table 30. Negative FI Distribution by Load and Hydro Scenarios in Spring

# of hours w/ negative FI in Summer Simulations		Load Scenarios High	Medium	Low	Total
Hydro Scenarios	High	168	0	12	**180**
	Medium	149	0	0	**149**
	Low	172	0	0	**172**
Total		**489**	**0**	**12**	***501***

Table 31. Negative FI Distribution by Load and Hydro Scenarios in Summer

# of hours w/ negative FI in Summer Simulations		Load Scenarios High	Medium	Low	Total
Hydro Scenarios	High	114	8	0	**122**
	Medium	129	15	0	**144**
	Low	125	0	0	**125**
Total		**368**	**23**	**0**	***391***

Table 32 and Table 33 below show the distribution of all the negative FIs on candidate paths upon all the scenarios grouped by the number of pivotal players withdrawn. These tables were requested at the stakeholder meeting held after the first release of preliminary results in June. Not surprisingly, most of the negative FIs occurred when three players were withdrawn from the market.

Table 32. Negative FI Distribution by Number of Suppliers Withdrawn in Spring

Candidate Path	Mininum FI				Percentage of hours with negative FI				# of hours with negative FI			
# of company withdrawn	0	1	2	3	0	1	2	3	0	1	2	3
Contra Costa 230kV Import			-0.01	-0.01	0.0%	0.0%	0.0%	0.1%	0	0	2	6
ElCentro 230/161 kV Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
HUMBOLDT_BG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Humboldt Bank		-0.03	-0.03	-0.03	0.0%	0.1%	0.2%	0.2%	0	3	9	9
Imperial Valley Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
MIGUEL_MAXIMP_LNXFMRBG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Miguel 500/230 kV Banks					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Monta Vista - Jefferson				-0.02	0.0%	0.0%	0.0%	0.1%	0	0	0	3
Moss Landing to Metcalf				-0.79	0.0%	0.0%	0.0%	0.1%	0	0	0	8
PITSBRG_XFMRBG		-0.26	-0.27	-0.27	0.0%	0.7%	2.8%	4.4%	0	39	160	246
Pittsburg to San Mateo_E. Shore					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Ravenswood Cutplane					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Ravenswood to San Mateo					0.0%	0.0%	0.0%	0.0%	0	0	0	0
SDGEIMP_LNXFMRBG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
SDGE_CFEIMP_BG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
SOUTHLUGO_BG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Serrano Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla Banks 4 & 6					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla Banks 6 & 4					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla to Delta Switchyard					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla to Pittsburg					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Vaca Bank & Tesla Bank 6		-0.01	-0.02	-0.03	0.0%	0.0%	0.1%	0.1%	0	2	6	8
Victorville-Lugo (HA-NG)					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Vincent Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Jefferson - Martin 230kV Cable					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Total									**0**	**44**	**177**	**280**

Table 33. Negative FI Distribution by Load and Hydro Scenarios in Summer

Candidate Path	Mininum FI				Percentage of hours with negative FI				# of hours with negative FI			
# of company withdrawn	0	1	2	3	0	1	2	3	0	1	2	3
Contra Costa 230kV Import					0.0%	0.0%	0.0%	0.0%	0	0	0	0
ElCentro 230/161 kV Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
HUMBOLDT_BG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Humboldt Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Imperial Valley Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
MIGUEL_MAXIMP_LNXFMRBG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Miguel 500/230 kV Banks					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Monta Vista - Jefferson					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Moss Landing to Metcalf			-0.46	-0.61	0.0%	0.0%	0.1%	0.4%	0	0	4	22
PITSBRG_XFMRBG		-0.15	-0.18	-0.18	0.0%	0.6%	2.4%	3.6%	0	31	132	200
Pittsburg to San Mateo_E. Shore					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Ravenswood Cutplane					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Ravenswood to San Mateo					0.0%	0.0%	0.0%	0.0%	0	0	0	0
SDGEIMP_LNXFMRBG				0.00	0.0%	0.0%	0.0%	0.0%	0	0	0	2
SDGE_CFEIMP_BG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
SOUTHLUGO_BG					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Serrano Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla Banks 4 & 6					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla Banks 6 & 4					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla to Delta Switchyard					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Tesla to Pittsburg					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Vaca Bank & Tesla Bank 6					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Victorville-Lugo (HA-NG)					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Vincent Bank					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Encina - Penasquitos 138 kV					0.0%	0.0%	0.0%	0.0%	0	0	0	0
Total									**0**	**31**	**136**	**224**

6 Concluding Comments and Next Steps

The simulation results and competitive test outcomes presented in this paper represent the updates introduced in the last version as well as the inclusion of adjustments to supplier portfolios to account for transfer of operational and bidding control of generation resources within the CAISO control area.

Seasonal results for the competitiveness test were consistent with expectations in that the highest pass rates were observed in the off-peak seasons of Fall and Winter. In addition, within the Summer and Spring seasons the highest pass rates were observed in simulations with fewer capacity withdrawn from the model, higher hydro availability, and lower loads.

Incorporating results from all seasons, 17 aggregated candidate constraints and all single candidate paths passed the competitiveness test. The single candidate paths are comprised of 84 individual transmission segments, and the 17 aggregated candidate constraints that passed collectively are comprised of 49 different individual line segments. This brought the total number of individual line segments that passed the competitiveness test to 133. Note that there are a total of roughly 4,860 individual line segments in the FNM and 160 of these were included in the testing as candidate paths.

These results are still preliminary, and we anticipate the final set of competitive path designations to be released in the first quarter of 2008 for application in MRTU.

The next release of preliminary CPA results, which will be released one month prior to the MRTU implementation date, will include the additional enhancements listed below.

- Updated Full Network Model.
- Updated input data including hydro and load conditions and associated bids, schedules, and operating levels.
- Updated list of candidate paths reflecting more recent real time mitigation data.
- Updated adjustments to portfolios to account for changes in operational and bidding control.
- Update of generating resources, including their relevant operating characteristics, anticipated 2008 MRTU period.